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Passing of the Gavel

JULY-AUGUST 1958

ARMED FORCES CHEMICAL ASSOCIATION

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The members of this Association, mindful of the vital importance to national defense of chemistry, allied sciences, and the arts derived from them, have joined together as a patriotic obligation to preserve the knowledge of, and interest in, national defense problems derived from wartime experience; to extend the knowledge of, and interest in, these problems; and to promote cooperative endeavor among its members, the Armed Services, and civilian organizations in applying science to the problems confronting the military services and other defense agencies, particularly, but not exclusively in fields related to chemical warfare. (From Art. II, AFCA Constitution.)

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FRONT COVER

Brig. General Clifford L. Sayre, USAR, newly elected president of A.F.C.A. grasps the business end of the official gavel extended by Mr. Glenn A. Hutt, outgoing president, in an impromptu "change of command" ceremony, Atlantic City, June 5.

PHOTO CREDITS

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Space requirements for reports of the Annual Meeting have necessitated leaving out of this issue our usual departments for A.F.C.A. Chapters and Chemical Corps News, as well as some other material. Such of the omitted matter, as is still timely, will be published in the September-October issue—Editor.

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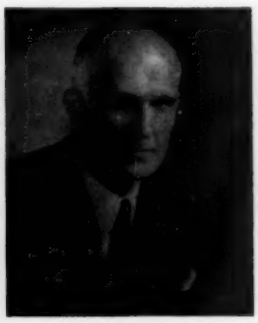

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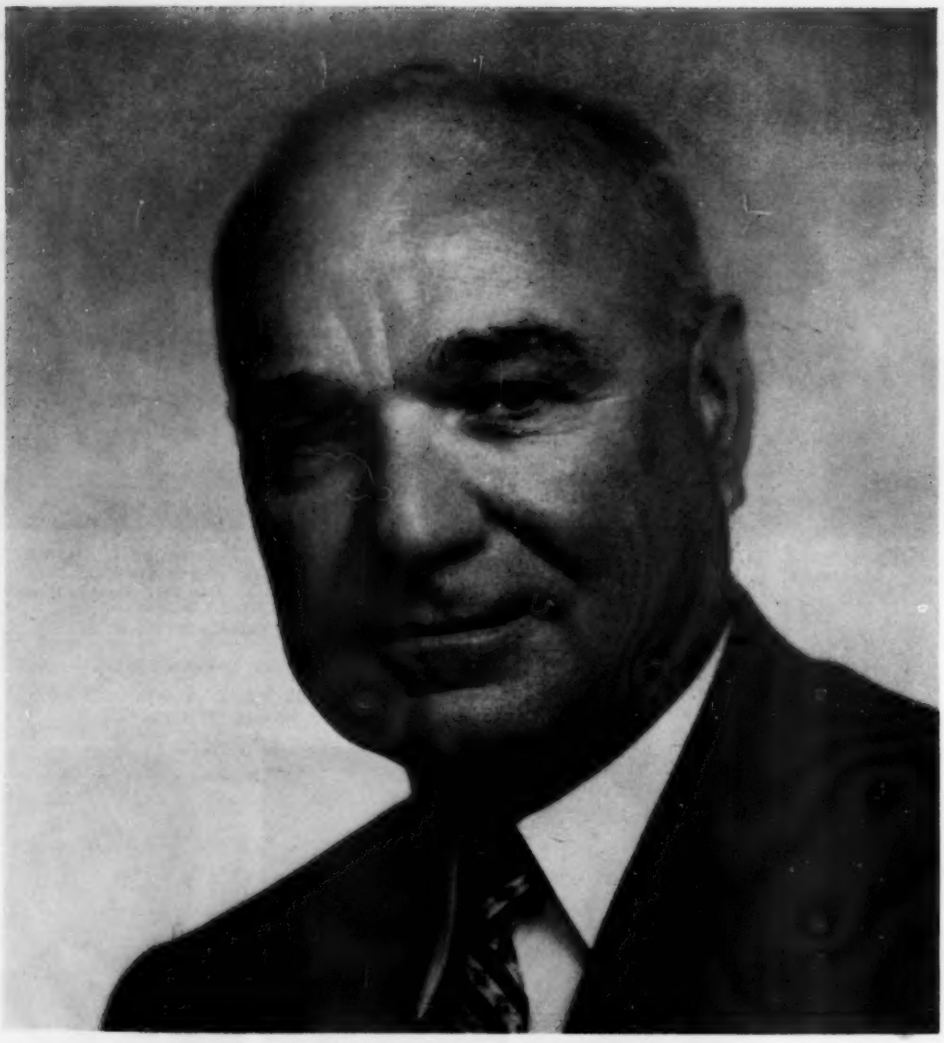

BRIG. GEN. CLIFFORD L. SAYRE, USAR

A. F. C. A.'s NEW PRESIDENT

A.F.C.A.'s new President, elected by the Board of Directors at the 13th Annual Meeting at Atlantic City on June 5, is Brigadier General Clifford L. Sayre, USAR.

General Sayre, a chemical engineer, is Director of Central Engineering for the Chemical Divisions of the Food Machinery and Chemical Corporation with offices in New York City. A charter member of A.F.C.A., General Sayre served as executive officer of the Materiel Command of the Chemical Corps during World War II. Recalled to active duty in 1951, he served during the period 1951-1953 as Commanding officer of the Chemical Corps Engineering Agency, Army Chemical Center. He currently holds a mobilization assignment in the Ready Reserve as Deputy Assistant Chemical Officer for Research and Development in the Chemical Corps.

General Sayre was born November 23, 1899, at New Brighton, Pa. He studied chemical engineering at Carnegie Institute of Technology and mechanical engineering at the University of Buffalo. He was commissioned in the Chemical Warfare Reserve on June 19, 1924 and has been in continuous reserve or active service. General Sayre's services during World War II drew upon his extensive engineering experience in chemical facility construction, particularly with respect to chlorine plants. He was awarded the Legion of Merit in 1945.

General Sayre is a member of the American Institute of Chemical Engineers and the American Society of Naval Engineers. He and Mrs. Sayre reside in Port Chester, N. Y.

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$1000 SCIENCE TEACHER AWARD

ROBERT A. FERTIG, veteran teacher of mathematics at Burlingame High School in San Mateo County, California, widely acclaimed in his State for his novel and inspiring methods of instruction, is this year's winner of A.F.C.A.,s Science Teacher Award.

Announcement of Mr. Fertig's selection was made at the 13th Annual Banquet of the Association at Atlantic City, N.J.

The award, established three years ago by the Board of Directors, is made to the person chosen by the Awards Committee as the most worthy from among candidates nominated by the various chapters of the Association throughout the country. A person to be nominated must be a teacher of science or mathematics in the secondary school system or one who having served as such a teacher is currently employed in the system in a supervisory capacity. This award is one of the means adopted by the Association in furtherance of its long-standing program to promote the scientific manpower of the nation. Through the award the Association seeks to stimulate study of science or mathematics by recognizing outstanding efforts.

Mr. Fertig is head of the Mathematics Department of the Burlingame High School. He has been teaching mathematics there for the past thirty years, except for a three-year period during World War II when he served in Naval Intelligence. Now, in addition to administering his department, he conducts instruction in advanced mathematics for 100 students. He is also chairman of the Department Heads of Mathematics in the San Mateo County Union High School District.

Mr. Fertig is noted for his success in arousing enthusiasm and interest among his students by organizing them in "engineering companies." In one such project he created the mythical "Burcal Engineering Corporation," sending letters to his students with that heading, assigning tasks and styling himself as the company's chief engineer. Mr. Fertig obtained his Master's degree in Mathematics from the University of California at Berkeley in 1927.

40TH ANNIVERSARY OF THE CHEMICAL CORPS

The United States Army Chemical Corps observed the 40th anniversary of its activation as a technical service of the Army on Saturday, June 28 with elaborate ceremonies held at the Army Chemical Center, near Edgewood, Maryland.

Included in the scheduled events, which were open to the public, were a parade of troops; displays of the Corps' protective equipment, munitions, weapons and smoke producing devices, and tours through laboratories, manufacturing plants and the Museum.

Historically, the Army Chemical Center is not only the birthplace of the Chemical Corps, but traces its history as a headquarters for Chemical Warfare to almost a year before its parent organization was officially activated.

When the German Army launched the first gas attack against allied troops at Ypres, Belgium, on April 22, 1915, the United States was still at peace. However, the American government officials realized that this introduction of a new concept in modern warfare had to be faced and protective and retaliatory measures devised.

Under sponsorship of the Bureau of Mines, a small government group began assembling information on the subject of toxics and their application in warfare. Headquarters for this mission was the American University at Washington, D.C.

Prior to 1918 the responsibilities for the various aspects of chemical warfare were divided among several services, Medical, Ordnance, Signal and Engineers.

The War Department created the Chemical Warfare Service on June 28, 1918, with the responsibility of research, development, supply and manufacture of offensive and defensive items in the Chemical Warfare field —thus placing under one organizational structure the missions previously "farmed out" to several other branches of the Army.

The Gunpowder Reservation, later called Edgewood Arsenal and more recently renamed The Army Chemical Center, has had a colorful history. It was first settled by Thomas O'Daniel in 1620 under a grant obtained from Lord Baltimore. Colonel John Maxwell, officer in charge of military forces guarding the frontier of the province, came to the Neck in 1720 where he died in 1728 and the property was taken over by his son, Captain John Maxwell. A portion of the Chemical Center is named "Maxwell Point."

During the Revolutionary War, British war vessels sometimes anchored in the Gunpowder River near Maxwell Point.

General George Cadwalader later bought portions of the Gunpowder Neck, enlarged the existing home and named it the "Mansion House."

COL. WILLIAM H. WALKER
Commanding Officer, Edgewood Arsenal, World War I

Trees from many parts of the world were brought to the estate and transplanted by Cadwalader. This collection of rare trees was an attraction to many visitors over the years. Some still exist in the Maxwell Point area.

When in 1915 gas was employed by the German Army at Ypres, the stage was set for a new role in the history of the Gunpowder Neck. The Trench Warfare Section of the Ordnance Department was given the assignment of obtaining toxic gases and filling shells. It was decided that a government plant would be necessary, and the Gunpowder Neck, present location of the Army Chemical Center, was annexed by proclamation of President Woodrow Wilson.

It was not until a year later, however, on June 28, 1918, that General Peyton C. March, War Department Chief of Staff, signed General Order Number 62, providing for the activation of the Chemical Warfare Service as a separate branch of the Army.

Pay Day at old Edgewood Arsenal, Maryland—Early 1920's

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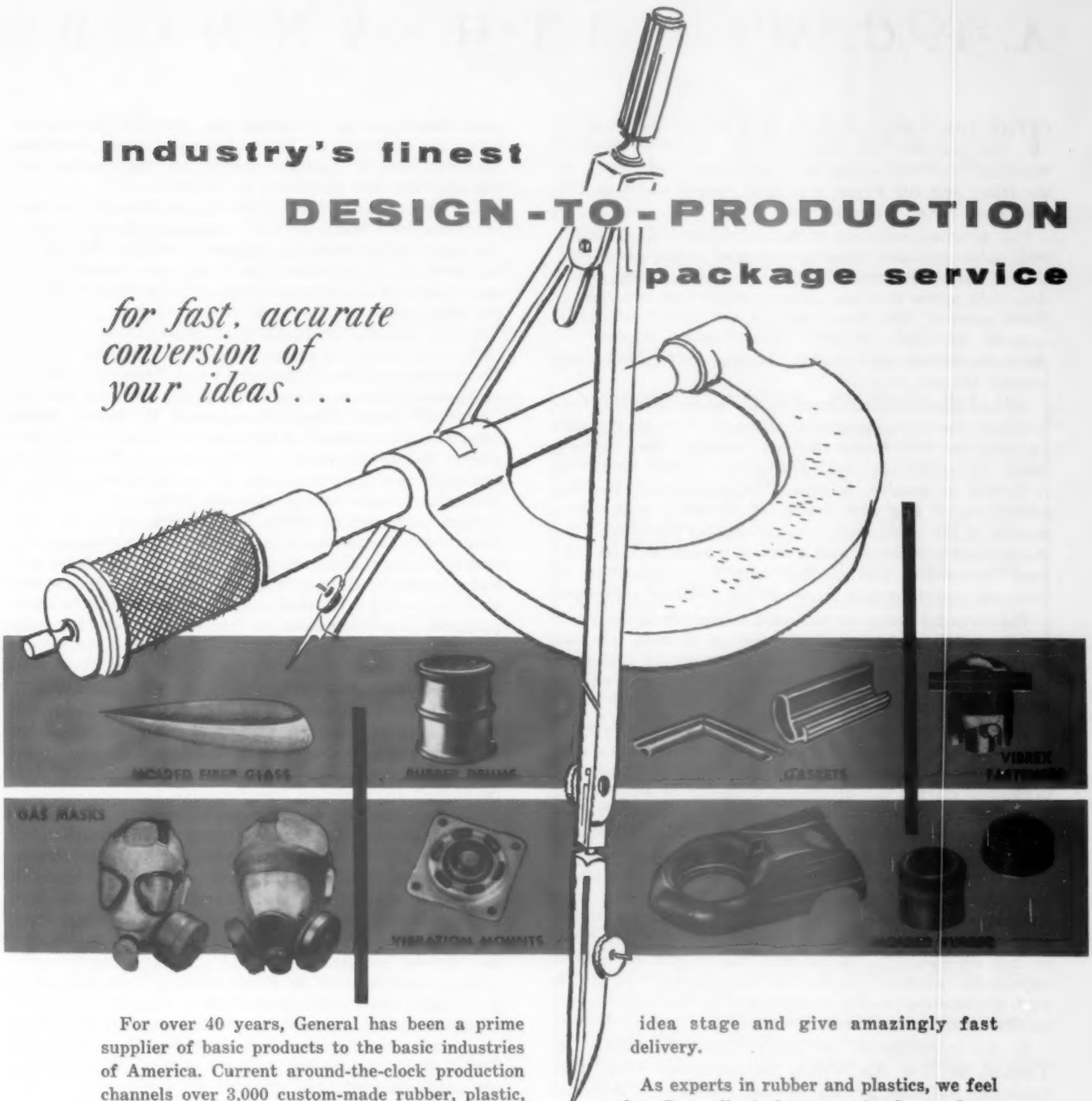

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A. F. C. A.'s 13TH ANNUAL

THE 13th Annual Meeting of A.F.C.A., centered on the theme, "The Role of the Army in Modern Warfare," but including also impressive addresses on the Navy and Air Force, was held June 5 and 6 at The Traymore hotel, Atlantic City, N.J.

The program was one of the most carefully planned, well publicised and expertly managed of any the Association has produced. It is believed all concerned would definitely agree that the Army, which had the role of "host service" this year, carried out that function in a most thorough, efficient and pleasing manner; so much so, indeed, as to merit the comment, "Above and beyond the call of duty."

As had been foreshadowed by the small advance registration, the attendance was not heavy, though it might be said—in fact many did say so—that the meeting made up in interest, enthusiasm and caliber for what it lacked in number present. The attendance, pending official count, was reported as 200. It was a good cross-section of the membership, as to member companies, the Association's chapters and military personnel. The current "recession" and conflict with other meetings or business commitments were among reasons expressed.

The two-day program included addresses by fourteen speakers—all members of the Armed Forces. All, but one, members of the uniformed services. In line with the accent on the Army this year, all but two of the speakers were from the Department of the Army.

The broad problem of national defense, reflecting respectively the roles of the Army, Navy and Air Force as viewed by a speaker from each of these services, was presented during the afternoon program of June 5, the first day of the meeting. All three of these addresses emphasized deterrence of war. Those of Major General J. E. Theimer, for the Army, and Vice Admiral T. S. Combs, the Navy speaker, gave considerable attention to the importance of adequate measures for dealing with limited war as an eventuality more likely than an all-out war of total destruction. A limited war was described as not necessarily a small war, but a war of limited objectives—whether nuclear or non-nuclear—in which such devastating results as envisaged by the term all-out nuclear war are not sought.

In the presentation of Lieut. General William H. Tunner, of the Air Force, he took the view that measures for coping with all-out warfare on a global scale would, in the circumstances, contain the requirements for dealing with lesser, local situations. Extensive excerpts from all of these significant, thought-provoking speeches are presented in this issue.

The second day of the meeting was devoted to presentations by Chiefs, or their representatives, of all of the seven separate technical services of the Army. It is believed that this is the first time at a meeting of this nature where all of these services were represented in one program.

Major General William M. Creasy, Chief Chemical Officer, followed by Colonel Ronald L. Martin, Deputy Commander of the Chemical Corps' Research and Development Command, presented the picture for the Chemical Corps. There was a note of rather special interest in the Chemical Corps at the meeting attributable to the considerable publicity recently given to General Creasy's review of the Chemical Corps program before a Congressional sub-committee on the Army budget estimates for 1959. This review included reference to the possibility of development for military purposes of what General Creasy called "psycho-chemicals," compounds which could cause persons exposed to them to act irrationally by upsetting their behavior patterns. Some allusions to this were included in subsequent addresses, not only that of Colonel Martin, but later in the banquet speech also by General Trudeau.

Major General A. T. McNamara, the Quartermaster General, the next speaker listed, was prevented by an attack of laryngitis from attending the meeting. His interesting discussion of the current Quartermaster problems and achievements was presented by Colonel John D. Martz, Jr., Chief of the Research and Development Division of his office. This was followed by a well-organized address on Quartermaster scientific developments by Mr. C. N. Gardner, also of the Quartermaster General's office. The increasing application of science to Quartermaster Corps problems was evident from these talks on subjects ranging from new means of rationing to methods of air-drop of supplies to troops in the field.

Brigadier General A. F. Cassevant, Commandant of the Signal Corps School at Fort Monmouth, N.J., told of the wizardry of modern electronics in communications and other Signal Corps activities, stating that the Signal Corps worldwide network deals with some 360,000 messages each day.

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MEETING—GENERAL REPORT

Of much interest to the attending members also was the address by Brigadier General John G. Shinkle, commanding the Army Rocket and Guided Missile Agency at Redstone Arsenal, Alabama. General Shinkle reviewed the Ordnance field—particularly the Army missile program which he illustrated with slides.

Next came a discussion of the role of the Medical Corps, particularly with respect to Preventive Medicine, or "Health Maintenance" problems and measures. This phase of the military program was presented in interesting and entertaining manner by Major General Silas B. Hays, the Surgeon General, and Colonel J. R. Hall, Jr., of the Office of the Surgeon General.

The concluding two speeches were somewhat complementary. That of Brigadier General Robert C. Tripp, Assistant Chief of Transportation, discussed new transportation problems and means. While giving full credit to the possibilities of aerial transport, General Tripp noted the continued importance for the foreseeable future of conventional types of transportation.

Brigadier General J. L. Person, as the representative of the Corps of Engineers, likewise emphasized the importance of roads and road-building in military operations as a continuing Engineer function even in this highly technological age.

THE climax of the meeting with reference to the Army's role in modern warfare was the banquet speech of Lieut. General Arthur G. Trudeau, Chief of the Army's Research and Development. General Trudeau, who has just recently assumed his present duties, proved a dynamic and forceful speaker. He presented a broad view of today's Army, stressing the high quality of its personnel and armament and its readiness to meet any situation that might confront it.

The prepared text of General Trudeau's speech is presented in full in this issue of the JOURNAL. Limitations of available space have necessitated use of excerpts from the other addresses for this report of the meeting.

The business affairs of the Association, which occupied the Board of Directors at their closed meeting on the morning of June 5, included some matters of major importance and interest generally to the membership. These were reviewed briefly for the benefit of the entire Association at the General Meeting which followed directly after that of the Board of Directors.

Outgoing President Glenn A. Hutt, who presided, first announced the list of officers unanimously elected by the Board for the forthcoming year. These are as follows:

President—

Brigadier General Clifford L. Sayre, USAR
Director for Central Engineering
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New York City, N.Y.

PICTURE CAPTIONS—PAGES 8, 9 & 10

1. Chairman Jackson and some of his aides. L. to R.: Donald MacArthur, Koppers Co., Washington, D.C.; Walter Sykes, Allied Chemical, New York; Lt. Col. Timothy Williams, Chemical Corps; Col. Harry Kuhn, USA-Ret., Washington, D.C.; J. V. Keneally, Union Carbide, New York; Dr. Wendell F. Jackson, DuPont, Wilmington, Del.; C. H. Carter, Atlas Powder, Wilmington, Del.; Col. P. B. Melody, USA, Army Information Officer; A. P. Storm, DuPont, Transportation Committee; Col. T. P. Gahan, Chemical Corps, Hqrs., First Army, Governors Island, N.Y.; Mr. Glenn A. Hutt, Ferro, Cleveland, Ohio.
2. Mr. Russell Aaronson of Aberdeen Proving Ground, Md., examines Ordnance Exhibit.
3. Sgt. Martin W. Johnson assists visitors at Signal Corps display.
4. Lew Terry and E. F. Binkerd of Midwest Chapter are shown Air Force Exhibit by Airman Charles R. Cox.
5. Vice Adminral T. S. Combs is snapped with sailors on duty at the Navy Exhibit.
6. Specialist Allan Stone, of Ft. Belvoir, Va., demonstrates Exhibit by the Corps of Engineers.
7. A group of A.F.C.A. ladies ready for wheeled-chair tour of the famous Atlantic City Broadwalk.
8. Partial view of the 13th Annual banquet at the Traymore.

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Lt. Colonel Walter E. Spicer, Jr. (re-elected)
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Lititz, Pennsylvania

The new Executive Committee was expected to hold its first meeting in Washington, D.C., July 14, for election of the Secretary-Treasurer and the General Counsel as additional officers of the Association for the ensuing year.

AN important decision of the Board of Directors, announced by Mr. Hutt, was that for the holding of the next three annual meetings of the Association in Washington, D.C. In this connection it was noted that the Executive Committee will give consideration to the holding of these meetings in the Fall rather than the Spring of the year. The Constitution requires the Board of Directors to hold a board meeting in the Spring of each year but does not make any stipulation with respect to the General Meeting of the Association.

The awards made by the Association this year included the Association bronze plaque for "Distinguished Service to A.F.C.A.," which was presented to Mr. Hutt by the President-elect, General Sayre. Then there was the Association's Safety Award, which was presented to Fort Detrick, Maryland, this year. This award, made annually to the installation of the Chemical Corps which evidenced the greatest improvement in its safety record during the year, was received on behalf of Fort Detrick by Colonel Donald G. Grothaus, the post commander.

A brief statement was also made at the General Meeting in regard to a report on a study made by Mr. Harry A. Wansker, Chairman of Membership and Organization Committee, on possibilities of interesting a Foundation for scientific or allied interests in the work of the Armed Forces Chemical Association. No final conclusion in reference to this study has been reached but continuing efforts to promote possible support of the Association's projects by one or more Foundations was noted.

The annual Science Teacher award, which the Board of Directors decided to continue for the forthcoming year, was won this year by Mr. Robert A. Fertig, High School teacher of Mathematics, Burlingame, San Mateo County, California. Mr. Fertig was not present at the meeting but an announcement of his winning the award was made by outgoing President Hutt at the annual banquet. (See separate article about this award in this issue.)

An extraordinary feature of this year's meeting was the array of exhibits by all three of the Armed Forces—Army, Navy and Air Force—displayed in one of the large exhibit halls of The Traymore. These included various types of panels, illuminated diagrams and pictures, models and full-scale samples of various munitions and items of equipment. All technical services of the Army were represented. The Navy's exhibit featured ship-carried missiles, while the Air Force exhibit traced the development of aeronautics from the wings of the mythical Greek Daedelus and son, Icarus, to modern jet aircraft and rockets.

THE General Committee in charge of Arrangements for the meeting was headed by Dr. Wendell F. Jackson, of the Wilmington Chapter, and included experts in finance, public relations, advertising and other pertinent fields drawn from member-companies of both the Wilmington and New York Chapters. Among these assistants who shared especially heavy loads were Mr. J. V. Keneally, Mr. Richard Giovine, Mr. E. Jusko, of New York, and Mr. W. Rice Yahner of Wilmington, all of the Program, Publicity and Advertising sub-committee; Mr. Joel Henry of New York, Finance Committee;

Mr. Walter H. Sykes, New York, Arrangements and Banquet sub-committee, and Mr. A. P. Storm, Wilmington, Transportation Committee. Mr. Henry Marsh, Wilmington, had been active as head of the Exhibits Committee. Unfortunately, illness prevented his attending the meeting. Also assisting Dr. Jackson were a number of military personnel. These included—Colonel P. B. Melody of the Army Information Office, as the Armed Forces representative; Lt. Colonel Timothy Williams, of the Chemical Corps, together with members of the Technical Liaison Branch of the Chemical Corps, including Mr. Floyd Brinkley, Chief of the Branch, Captain Patricia L. Bouldin and Captain Rebecca L. Bennett, WAC members of that office.

General arrangements for the meeting, including the organization, transportation and the layout of the exhibits and provisions for exhibit personnel, etc., were coordinated under Colonel Theodore P. Gahan, Chief Chemical Officer, First Army, Governors Island, New York, who had been designated as Project Officer for the meeting.

The chapter sponsorship for the meeting this year was shared by the New York and Wilmington Chapters. This was duly recognized in the arrangements for supervision of the program. President Hutt functioned as Chairman during the entire first day's session, but for the second day representatives of both Chapters shared this role. For the morning session of the second day Mr. Charles H. Carter, of Wilmington, presided in the place of Mr. Henry T. Clark, President of the Wilmington Chapter, who was unable to attend that part of the program. For the afternoon session the Chairman was Mr. James Sheridan, President of the New York Chapter.

An especially noteworthy feature of which many members expressed approval was the resort this year to a small pocket-size program, rather than the larger souvenir type program with advertisements, which is the type generally provided heretofore. To help finance the production and distribution of the program, contributions were received from a number of companies. These were:

Armour & Company, Chicago, Ill.
Astra Pharmaceutical Products Co., Inc., Worcester, Mass.
Bechtel Corporation, San Francisco, Calif.
Blaw-Knox Company, Pittsburgh, Pa.
Celanese Corporation of America, New York, N.Y.
Commercial Solvents Corporation, New York, N.Y.
Englehard Industries, Newark, N.J.
Hercules Powder Company, Wilmington, Del.
Heyden Newport Chemical Corporation, New York, N.Y.
Merck & Company, Inc., Rahway, N.J.
Proctor & Gamble Company, The, Cincinnati, Ohio
Shell Development Company, Emeryville, Calif.
Sun Oil Company, Philadelphia, Pa.

THE Association was fortunate in having glorious weather for its two-day gathering, but the full schedule gave little opportunity to take advantage of Atlantic City's beach and famous Boardwalk. Included in the program was an excellently attended cocktail party at the end of the first day. On the second day there was a luncheon for the members, and for the ladies a separate luncheon and Boardwalk ride in the famous "seats-for-two" wheeled chairs. The final evening was taken up with the banquet, as usual a gala

(Continued on page 25)

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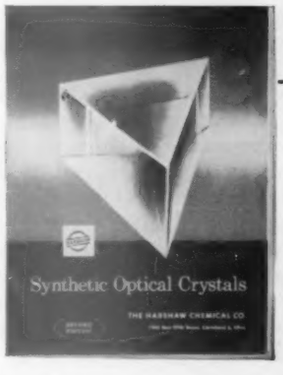

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THE BANQUET SPEECH

Spirited address by the Army's new R&D Chief is climax of A.F.C.A.'s 13th Annual Meeting Program at Atlantic City. He warns against complacency; invites continued aid from chemical industry; is impressed with retaliatory possibilities of CBR field, and mentions increase of funds this year for Chemical Corps programs. Following is full text of speech by—

LT. GEN. ARTHUR G. TRUDEAU, USA
Chief of Research and Development, Department of the Army

I APPRECIATE very much this opportunity to participate in this gathering—to address a group which has a major objective of advancing national defense. It is peculiarly appropriate that we meet here today at the Traymore Hotel which, as part of the Army's first Rehabilitation Center during World War II, housed thousands of our soldiers recovering from their wounds, for today marks the 14th anniversary of the great Normandy Invasion during which so many of those soldiers became casualties in the greatest allied effort in history.

Fourteen years ago today, Americans everywhere tensed as word came from London that the assault of Fortress Europe by land, sea and air was underway and that our troops were storming the beaches of Normandy. The door to victory had been opened on the sea and in the air but the final decision awaited the arrival of the G.I. with his feet in the mud and his heart steeled for action. America listened anxiously for word that the landing was a success. It was, but like all victories, it was not without cost. Many of our finest sons died or were maimed in that operation as they drove over the beaches through the bocage country and on to Paris and the Elbe.

I pause to pay tribute with you to those gallant men. They must not be forgotten as we meet here today.

Much has happened since that great assault on Fortress Europe. The complexion of the world we live in and of war itself have been radically altered in the intervening years. In the Missile/Nuclear Age we now live in, we may never again witness a military phenomenon like Normandy—when many tens of thousands of men from thousands of ships poured over a few narrow beaches or were air-dropped in the rear to make a successful lodgment on the European Continent. The day of the massed attack by thousands of men over restricted beaches heavily defended by the most modern weapons has passed. In its place, a new concept of extremely wide and deep combat zones in which lean, mobile, powerfully armed and dispersed units move and fight, is developing. This concept of warfare has inspired the initial reorganization of our Army with a new name—the pentomic Army.

The pentomic Army is both embryo product and symbol of the atomic age. As such an embryo, it is a continuing concern to Army Research and Development, which develops the tools which this Army will be prepared to use tomorrow. These will have a dominating effect on our future organization, tactics and techniques. The new pentomic division, or five-sided, atomic division, has already replaced the basic World War II triangular equivalent in the active Army.

In the pentomic Army, the regiment and battalion are eliminated as fighting units, and are replaced by five "battle groups" in each pentomic division. Each group reinforced can operate independently. Each battle group has companies incorporating more men and increased firepower. However, I consider the present changes to be very small compared with the development of weapons and tactics to come in the next decade.

With today's great capability for massive destruction, it becomes plain that the primary role of the United States Army as well as the Strategic Air Command, and the entire Nation, must not only be to win another World War if it is forced upon us, but more importantly perhaps, to *deter* one; to be so well equipped and so quickly responsive that no potential enemy will seriously consider precipitating global, thermonuclear or even limited war. Considering the relative degree of adequacy with which both sides are prepared for thermonuclear war, neither side can really win—it is only a question of the relative degree of destruction that will follow.

WE cannot assume, therefore, that a future war would either be one in which both sides would resort to unrestricted employment of nuclear weapons or that it would be fought entirely with conventional weapons, meaning gunpowder and steel, on the land, in the air, and on or under the sea. Our concepts cannot be that narrow. Neither history nor sound military logic supports either extreme view. The preparations made by our potential enemy certainly indicate that they are thoroughly prepared for any kind of offensive conflict and will undoubtedly choose the type in which we are weakest. The next war, if any, could be one with any or no scale of atomic usage. It could be entirely non-atomic; it could be another Korea-type; it could be atomic in the battle area only or it could be chemical-biological-radiological. Obviously, we must be fully prepared, then, for a great variety of warfare forms—a complete spectrum—from global, thermonuclear down to small-scale, limited, even guerrilla—with or without CBR agents—with or without small-yield atomic weapons.

In our preoccupation with global, thermonuclear concepts, we dare not neglect any longer preparedness for limited, local wars, without dire risk to our survival. If past is indeed prologue, let us then examine the past.

Since the atomic age opened over Hiroshima 13 years ago, Communism has achieved its end consistently through intrigue, subversion and limited, non-nuclear war. Since the Second World War, Communist forces—the USSR or its satellites—have engaged in eight of the 14 small wars which have occurred, despite U. S. possession during that period of the deterrent of an atomic superiority which for a time was a complete monopoly.

Territorial aggrandizement by local war is nothing new to the Communists. Their forces have fought in 14 local wars during the past 40 years. In no less than 12 of these, their aim was to extend their political and territorial power. The unfortunate situations today in the Lebanon, Indonesia and France and North Africa are all irrefutable demonstrations of the importance and impact of land forces since the natural habitat of man and the area he must continue to control is the two-dimensional surface of this earth, no matter how high above or below it he goes or what we find in space.

The proponents of international Communism find limited war a relatively cheap way to gain territory when cold war efforts are rebuffed—and use it without legal involvement as belligerents, even though they are full participants morally. You are all acquainted with the limited war technique of the Soviets in exporting so-called "volunteers," including the Chinese aggression in Korea. In fact, in most of the conflicts since World War II, troops have been provided by the Soviet satellite countries. Their men have been cheaply armed and equipped but available in large numbers. They have relied on the sheer weight of manpower to which they ascribe little value, rather than on the capabilities of machines. You know how the Communists in Korea used saturation attacks as each successive wave of men trampled over the dead of preceding waves. The battle against those to whom human life has little value is difficult but the only alternative to resistance is to succumb to the Communist determination to dominate the world. Surely, no one who knows the teachings of Marx, as more radically interpreted by Lenin, Stalin, Krushchev, and others, can have any doubt as to their complete scorn, disregard and disavowal of the best code of international ethics and morals man has been able to evolve over the last 2,000 years.

COMMUNIST techniques indicate some of the reasons why we must prepare to meet a wide range of challenges—by increasing our conventional firepower and increasing the efficiency of our means of delivering it; by increasing our land and air mobility; by improving our facilities and techniques for communication and surveillance and by increasing our air-transportability.

I have described the pentomic division designed for atomic warfare. Some of these new divisions have been grouped recently to meet the initial requirements of limited war as well as to provide initial reinforcements in general conflict. Our newest grouping is called STRAC, or Strategic Army Corps. Its slogan—"Skilled, Tough, Ready Around the Clock."

STRAC is the Army's mobile combat-ready forces specially tailored to move promptly by air or sea to potential trouble spots anywhere in the world. It is comprised of the Headquarters XVIII Airborne Corps and 82nd Airborne Division at Fort Bragg, North Carolina; the 101st Airborne Division at Fort Campbell, Kentucky; 4th Infantry Division at Fort Lewis, Washington; 1st Infantry Division at Fort Riley, Kansas, and supporting units.

STRAC has been organized to support this country's initial moves in any war anywhere in which we must fight against further Communist aggression, and to be ready to move as fast as long-range aircraft can be made available.

In a global, thermonuclear as well as in limited, war the Army must also have STRAC's two basic capabilities of offense and defense readily available. In all-out conflict our mobile forces, equipped with our most modern weapons, can be brought readily, when mobilized, into play to provide such devastating but discriminating firepower as may be necessary. Army forces would be required not only to destroy enemy forces and secure critical territory, assisted by our allies, but also to occupy his land pending establishment of a new and free government that would restore some reasonable degree of peace to this hectic world.

Defensively, we must realize that this Nation's capability to defend North America and the continental United States against thermonuclear attack will vitally influence the outcome of a war now that thermonuclear attack capabilities are closely matched. So the Army's growing capability to exert maximum power against enemy aircraft and missiles directed against this continent assumes vital importance.

The Army has been in the business of air defense since the advent of aircraft, first with anti-aircraft artillery and now with guided missiles. We pioneered the first operational surface-to-air guided missile, NIKE AJAX, which has been helping to guard the Nation for more than five years. We have thousands of highly trained air defense and guided missile troops on station. We have fired many hundreds of AJAX missiles in our various test and training programs. One unfortunate accident recently in no way affects the efficiency of this well proven and tested missile. It could as well have been an airplane that crashed or an explosion in the turret of a ship.

This month another historic milestone in air defense begins. The second generation of NIKE AJAX, called NIKE HERCULES, is beginning to replace AJAX. HERCULES has much greater range, altitude and speed than AJAX and its operational capabilities far exceed those of any known or contemplated aircraft. AJAX is still a formidable weapon, however, capable of defeating supersonic aircraft, and we are prepared to demonstrate that it can defeat any bomber known to be operational today. HERCULES, however, with its atomic warhead, can destroy a whole formation of supersonic aircraft or cruise missiles no matter how high they choose to fly.

This NIKE family provides the Army with its high altitude capability against any known enemy aircraft. To provide low level protection for the continental United States and for Army forces in the field, we are producing the HAWK, which is highly effective against low-flying aircraft.

UNDER development now are the anti-missile missiles, NIKE-ZEUS and PLATO. ZEUS is being designed to protect the United States against intercontinental ballistic missiles and PLATO is its mobile counterpart for the field army. To the greatest extent possible we plan to use interchangeable components in the two systems. Obviously, however, since ZEUS will be a static system in fixed defenses, while PLATO will be a mobile system, some of the equipment will have to be different for the two systems. While no defense against a long-range ballistic missile exists today, offensive and defensive capabilities in the long-range missile field are growing both in this country and elsewhere, and it becomes increasingly difficult to deny the devaluation of the bomber and the fighter plane and the

serious need for an anti-missile missile. A missile will out-perform any aircraft made and a good missile with an atomic warhead launched against them is their death certificate.

While ZEUS is primarily being developed as defense against the ICBM, it has very impressive capabilities against shorter range ballistic missiles, air-supported missiles and manned aircraft.

We in the Army are proud of the missiles we have developed for the nation's defense. We are also proud that it was an Army missile which moved this nation's first satellite into space. No matter who has primary responsibility for future development, we will be glad to contribute our demonstrated capability in this work for the defense of our nation.

Research and development presents a great dilemma today. We must devise the means to fight wars ranging from guerrilla action to thermonuclear war, but out of all the problems we must solve in order to penetrate the uncertain future, a few facts stand forth hard and clear.

Basically: The task of ground forces is to deny success to an enemy and achieve victory by his destruction or surrender. To achieve this: First, there must be greater emphasis on the increasing lethal quality of all weapons systems our scientific genius can discover and develop if we are to survive. In this field we seek your increased support. Two: We must quickly improve our capabilities for better target acquisition, combat surveillance, and communications. Three: We must place much heavier emphasis on improving our air and ground mobility.

I have dealt with firepower to some extent—offensive and defensive. Let us consider the second point—target acquisition and combat surveillance. Combat intelligence must use the latest advances in science and technology to gain early information of the enemy and to locate the most profitable targets for our weapons, both ground and air.

The term, combat surveillance, is new, but the function has long been performed by armies in the field. It means the all-weather, day-and-night, systematic watch over a battle area. Many of the physical limitation of the individual soldier as a collector of such information as comes within his purview will remain, but we are trying to give him faster communications to report what he sees.

Aircraft specifically designed for observation will be organic to each division. These can carry technical sensory systems, aerial cameras, television, radar and infra-red devices. Electronically controlled drones, or pilotless aircraft, for photographic reconnaissance will be available within the field army. Aerial cameras capable of high speed operation at increased altitudes will be used. Film will be automatically developed in multiple prints and interpreted at mobile field laboratories. Within minutes, resulting information will be in the proper hands.

WITH respect to mobility, I realize General Theimer yesterday dealt with this subject, but I should like to add a few remarks. One thing I want to emphasize is that weapons systems, especially those designed to deliver thermonuclear firepower from fixed locations, are especially vulnerable. Consider the history of the German V-2 during the Second World War. These missiles were thrown by the thousands from Dutch soil against London and Antwerp. At a time when the Allies had complete control of the air, no V-2 launching was ever thwarted by Allied action. Why? Because German army mobile rocket teams were able to move into any convenient Dutch village or grove, set up and fire a group of three missiles and move out within a period of a few hours.

The only complete failures in connection with the program were the massive fixed concrete bunkers with their missile launching pads built by Adolph Hitler against the best advice of his military commanders. These proved absolutely useless in the face of repeated Allied bombing.

Like all Army missile systems, the Army-produced IRBM JUPITER was conceived and designed as a mobile system. It has features incorporated into its guidance system, in its erector and in its launcher which permit rapid movement to newly-selected tactical firing positions unidentifiable by the enemy.

But mobility of weapons is not enough in the modern army. Mobility of movement, action, organization and thought are essential. Availing ourselves of every possible advance by all civilian and military agencies is probably the prime essential. Consider the field of basic research. While a considerable amount of basic research required by the Army is performed within the laboratories and installations of the Army's seven technical services, most of it is done through the medium of contracts with universities, non-profit institutions, and industrial laboratories. We are constantly searching for new ideas.

In addition, the National Inventors Council of the U.S. Department of Commerce, composed of qualified civilian scientists, engineers, and members of the military services, receives from individuals and organizations, ideas, suggestions, inventions and the like which have already been developed to varying degrees. The members evaluate each suggestion or invention and, if it appears to offer promise, refer it to the appropriate research and development agency of the Department of Defense for further study.

At the Department of the Army level is the Army Scientific Advisory Panel. This group of outstanding scientists and technologists was formed in 1951 to utilize fully the specialized knowledge and broad managerial experience that exists within the Nation's colleges and universities, private non-profit foundations and research organizations, industry, business and the professions, and government departments and agencies.

THE particular field in which your association is most interested—chemical—offers the possibility of very novel approaches. I am especially impressed by the obvious military possibilities of developing non-lethal gases which would incapacitate an enemy without permanently destroying him or the cultural or material symbols of man's progress over the centuries. A start has already been made on this development.

Another novel approach has been what General Creasy has called a psycho-chemical agent, a type which upsets behavior patterns. If chemical warfare must be used to retaliate against and rebuff an aggressor, the ability to produce further and temporary irrationality in the enemy would be of inestimable value. Surely both of these approaches envision a degree of humaneness not apparent in nuclear weapons if war again becomes unavoidable.

Whatever degree of preparedness in the CBR field we now possess and can further develop, the point which needs making again and again is that we must have real CBR counteroffense capabilities if we are not to invite disaster. I fully endorse this view, and have long been an active proponent of expanded efforts in the field you represent.

We have had ample warning from Soviet leaders that

(Continued on page 43)

NITROPARAFFINS

DIMETHYLAMINE

METHANOL

AMMONIA

FORMALDEHYDE

BENZYLTRIMETHYLAMMONIUM CHLORIDE

HYDROXYLAMMONIUM CHLORIDE

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CONCEPTS OF MODERN WARFARE

ARMY, NAVY and AIR FORCE

Speakers at the afternoon session of A.F.C.A.'s 13th Annual Meeting, Atlantic City, N.J., on June 5, 1958, discuss a point with outgoing President Glenn A. Hutt before the program. Left to Right: Vice Admiral T. S. Combs, USN; Lt. General W. H. Tunner, USAF; Mr. Hutt; Major General J. E. Theimer, USA.

THE ARMY

Excerpts from address to the Armed Forces Chemical Association at the 13th Annual Meeting at the Traymore Hotel, Atlantic City, N. J., on June 5, 1958, by—

MAJOR GENERAL J. E. THEIMER, USA

Assistant Deputy Chief of Staff for Military Operations for Programs and Budget, U. S. Army

THE United States is faced with a potential enemy stronger than any which has ever threatened us. He has the capability of striking this country and this city with his strategic forces. In Europe we are face to face with his most powerful force, which he can commit to aggression at any time. He poses a positive threat in such widely separated areas as Greece, Indo-China and Korea, where his satellites can without warning initiate aggressive action against our allies. In the Middle East the Soviets are attempting to infiltrate sensitive areas of the Arab world.

The Soviet Union has made tremendous strides in the improvement of its military forces since World War II. Today the Soviet Union's armed forces contain in excess of four million men. Their Army contains 175 active divisions, including 100 rifle divisions, 55 mechanized divisions and 20 tank divisions. The majority of these divisions are located in the border regions of the Soviet Union.

This modernized Soviet Army, the largest in the world, is capable of waging either an atomic or non-atomic war, general or limited, anywhere in the world.

Soviet military aviation is modern, up-to-date, and possesses the range capabilities which enable it to strike anywhere in the United States with nuclear weapons.

The Soviet Navy is likewise strong and equipped with the latest weapons.

The satellite countries have continued to improve their armed forces, with considerable Soviet assistance. This improvement has been reflected in some increase in the numbers of men; but the most significant increase and improvement is in the equipment, training, and mobilization capabilities. In the Far East, the Chinese Communist Army has a total of approximately two and a half million men. The North Korean and Viet-Minh Armies add to the Communist strength.

We must be prepared for war in the event that our deterrents fail to prevent aggression. The communist threat is one of degree and is commonly thought of in two terms, general war and limited war.

The total nuclear destruction and annihilation which constitutes our deterrent to a general war present an awful vision which fortunately has repelled even the most ruthless.

A more immediate and constant danger, which can be initiated at any time is an aggression of more limited scope. The gradual erosion of the free world position through piecemeal aggression around the Soviet periphery is an ever present threat to the security of the nation.

Limited war refers to something less violent and catastrophic than the total nuclear devastation which characterizes general war. Limited war might be defined as an armed conflict in which U.S. national survival is not *directly* at stake. It would probably be characterized by mutually accepted limitations on objectives, locale, weapons and participants.

The minimum objective in a limited war must be to preserve our allies and the free world and to halt further communist infiltration and aggression. Consequently one objective would be to restore or to maintain the situation as it existed prior to the outbreak of hostilities. Limited war may involve large scale casualties and destruction.

The successful accomplishment of the concept of deterrence is not within the capabilities of any one service or any one nation. Success is dependent upon the best efforts of all military forces of this country and its allies supported by the steadfastness of all freedom-loving people. This requirement has dictated the establishment of treaty organizations in various parts of the world and particularly in those areas where the threat is more serious. Whatever form any future aggression may take it will demand unity of action and purpose by America and its allies.

The Army contributes to the balanced deterrence of the national security team by:

(1) Maintenance of strong combat-ready forces overseas.
(2) Providing units and weapons for the air defense of the United States and our field forces.
(3) Maintenance of Strategic Army Forces earmarked for prompt response to limited aggression anywhere in the world or to reinforce our overseas deployment in case of general war.
(4) Organization of trained reserve forces in the United States capable of rapid mobilization.
(5) Development of the ground forces of our allies around the world.

The Army together with its Air Force and Navy brothers in arms has deployed around the world combat forces whose mission is deterrence.

Countering the Soviet air threat is the joint task of all air defense weapons, including aircraft and missiles. Here the Army contributes its share with the NIKE AJAX, our nation's first operational surface-to-air-missile. NIKE HERCULES, with initial deployment beginning this month, will have an atomic capability and increased range. HAWK with its ability to intercept and destroy low flying aircraft will soon be deployed and greatly improve our air defense capability. Later NIKE ZEUS, the Army's anti-missile-missile, will counter the threat of the inter-continental ballistic missile.

The Army maintains forces in the CONUS ready to move on very short notice wherever they might be needed throughout the world. Their mission is to reinforce United States forces already overseas or to respond to aggression wherever they are called on. This is the strategic reserve. It represents the "fire brigade."

This means too that the Army must have the strategic mobility to move at once to any place any time for any type operations. The Army is organizing its divisions and other units to achieve a high degree of air transportability and to lighten the load of those elements which must be moved by sea. However, the Army does not control the means necessary for strategic mobility. We must look to the Air Force and Navy to provide the transportation we must have.

Our reserve components constitute another valuable contribution to our deterrent strength. Our National Guard and Army Reserve are an integral part of the Army's strength.

The United States needs allies to resist the spread of communism, whose tactics may be creeping infiltration or open aggression. We perform an important role in helping to teach forces of forty-odd free countries how to use and maintain equipment made available under the military aid programs. The improved readiness of these allied units represents a significant contribution to the deterrence of war.

On the battlefield of the future the use or threat of atomic weapons will require greater dispersion of troops and installations. Consequently they can be expected to occupy areas of greater breadth and depth than in the past. We will find it necessary as in the past to fight for and hold vital areas, and the resulting battle may be characterized by many violent clashes of relatively short duration. The dispersion on the nuclear battlefield will not be limited to the fighting force, but will be found in administrative and logistical installations. This portends, as a corollary, more and smaller logistical facilities.

The dispersion and resultant need for depth to the combat zone points up the increasing need for missiles. Conventional artillery will continue in demand not only for the close protection and support of our troops but also in those places where atomic weapons might not be safely used. Guided missiles with ranges from a few hundred yards to many miles must be available to attack close-in objectives as well as to reach deep into the rear of the enemy's positions.

In developing Army forces prepared to exist and fight under these conditions four things are immediately apparent. We must:

(1) Increase our ability to locate targets on the battlefield.
(2) Increase our ability to deliver atomic and conventional fires.
(3) Reduce our vulnerability to the enemy.
(4) Increase our ability to exploit our own firepower.

Without a versatile and reliable ability to locate enemy targets, atomic weapons and missiles are of little use.

Long-range target acquisition is one of the complex scientific problems confronting the Army of the future. We foresee the possibility of obtaining effective location devices starting with radar and infra-red equipment, some carried in drones, which will vastly extend the Army's present observation capabilities.

The continued development of a wide range of low-yield tactical atomic weapons and diversified delivery means is essential for the future Army.

There will be many places and circumstances in which atomic weapons would not or could not be used. These will occur because of proximity to our own troops, weather conditions, or a number of reasons. Consequently the so-called conventional weapons must be progressively modernized and improved.

The chemical and biological field is vast, and the possibilities of these weapons are many. Their effect could be many times greater than when they first surprised our unprepared allies in World War I if appropriate emphasis is not afforded them.

Modern armies, with their elaborate equipment, are difficult to conceal, as are their logistical supporting echelons in the rear. Survival in battle is a continuously greater problem as weapons becomes more effective and their lethality increases. The improvement of cross-country mobility provides a useful means of reducing the enemy's ability to use his weapons against us.

Equally as important as any of the new weapons is the ability to exploit rapidly their effects. Increased tac-

(Continued on page 24)

THE NAVY

Excerpts from address to the Armed Forces Chemical Association at its 13th Annual Meeting at the Traymore Hotel, Atlantic City, N. J., on June 5, 1858, by—

VICE ADMIRAL T. S. COMBS, USN
Deputy Chief of Naval Operations
(Fleet Operations and Readiness)

THIS group represents an industry which has played a major part in keeping our Navy ready to perform its mission in the face of remarkable technological advances.

In an age when the Navy is shifting from oil to nuclear power; from guns to missiles; we who go to sea, must rely heavily on industrial research and development to keep abreast of the times.

In this respect, you of the Chemical Industry have been in the forefront.

Let me cite some examples:

Tomorrow's weapon presently under development by the Navy—our priority project—is Polaris, the fleet ballistic missile. As originally conceived, our ballistic missile was to be a huge, shipboard, liquid fuel rocket. To avoid the inherent hazards and the difficult problems associated with liquid fuels, the Navy inaugurated a solid propellant missile program with the submarine as the platform. The improved solid propellants developed have contributed much toward the smaller, lighter, safer and more economical Polaris submarine system—the optimum fleet ballistic weapon system. Indeed, your work has materially advanced the date by which we expect to have Polaris operational.

In a less glamorous vein than Polaris, but of significant importance, chemistry has challenged the shrinking defense dollar by recently developing a new process for manufacturing casting powder—which is used as a major ingredient in making propellants for several surface to air missiles. This process will result in savings of about 80% of the costs for loading the missiles.

Before we speak of the role of the Navy in modern war, it is well to set the stage on which our Navy will have to operate. We live today in a world atmosphere which continues to be charged with tensions and uncertainties. These tensions are not limited to any one spot on the globe, but are world wide. Despite their varied locations, these trouble areas stem from one focal point, Communist Russia. There has been no relaxation on the part of the Russians in their well documented programs of subversion, infiltration, and indirect agression. We know that Communism exploits weaknesses and the weak—that it permeates every facet of mankind's existence—both material and spiritual.

We cannot, with certainty, say which course Communist aggression will take next. The tide of Communism will, however, continue to ebb and flow—flow when the opposition is soft, divided, or perhaps indifferent—ebb when the opposition is spirited, hard and resonant. We will, however, for sometime to come, be faced with the possibility of an all-out war, the probability of limited and the certainty of cold war. These are the major threats to the free world security.

A cold war is the war for men's minds and economic advantages. The Navy, however, must be prepared to fight two kinds of hot war; all-out nuclear warfare, or a limited war of limited objectives.

In an all-out nuclear war the United States must have the capability to strike an aggressor with nuclear weapons no matter what preemptive action the aggressor might attempt.

To possess this capability, we must have a group of weapon systems so chosen that no single action nor any single technological advance can render all systems ineffective. Among the criteria against which these weapon systems should be measured are:

First—the weapons should be so located that enemy efforts to destroy them before they are launched would not collaterally wreak damage on the United States, the very area which, in the full sense, they are designed to protect.

Second—the bases or launch points should be as difficult as possible for an enemy to locate.

Third—the weapons should be as nearly as possible invulnerable to enemy attack before they are fired. And —the weapons should be as invulnerable to enemy counter-action as possible while on the way to their targets.

Now, how do we meet these criteria just cited—criteria which are so vital in an all-out nuclear war? There are several ways to reduce vulnerability. It can be done by hardening—by building more installations—by actively defending them. This is the fortress concept. On the other hand it can be done by making weapon systems mobile—by concealing them, rather than resorting to the rigid costly techniques of fortification. Generally speaking, the United States cannot expect to conceal fixed installations. The destructiveness of modern weapons is such that no fortress and no number of fortresses can be considered permanently invulnerable.

Mobility and concealment are the lasting answers. Mobility can be achieved to some extent on land, but concealment is more difficult. In sea based systems, on the other hand, the two reinforce each other. When we have adequate numbers of fleet ballistic missile submarines—and with missiles kept up to date to cope with enemy countermeasures near the target, we can have relief from the arms race.

However, the Navy will not depend solely on Polaris submarines. The Navy's carrier based attack aircraft and the jet seaplanes are ideally suited for low level penetration of defended areas. Naval retaliatory forces deployed at sea could well be the free world's ace-in-the-hole against all-out aggression. The assured delivery of just a few H bombs is sufficient to inflict terrible punishment and would produce a major disaster in any country. For this reason, appearance of the Navy's fleet ballistic missile submarines in the ocean depths will have a sobering influence on any who dare to contemplate general war. Make no mistake, to deter an all-out war and to meet it successfully if it comes, we cannot rely on any one weapon system, regardless of its degree of capability. We can only accomplish our purpose in a concerted team effort. We need, as I have said and would like to emphasize, a complex of weapons systems embodying all the mobility and flexibility that we can provide.

Your Navy has its role in all-out war as well as limited war. Our attack carrier forces have a very measurable capability and capacity for retaliation in all-out nuclear war. The very fact that these carrier forces are difficult to locate and difficult to attack once located, will cause any aggressor to pause and reflect before unleashing an all-out atomic war. In the near future we will have in operation nuclear powered sub-

(Continued on page 20)

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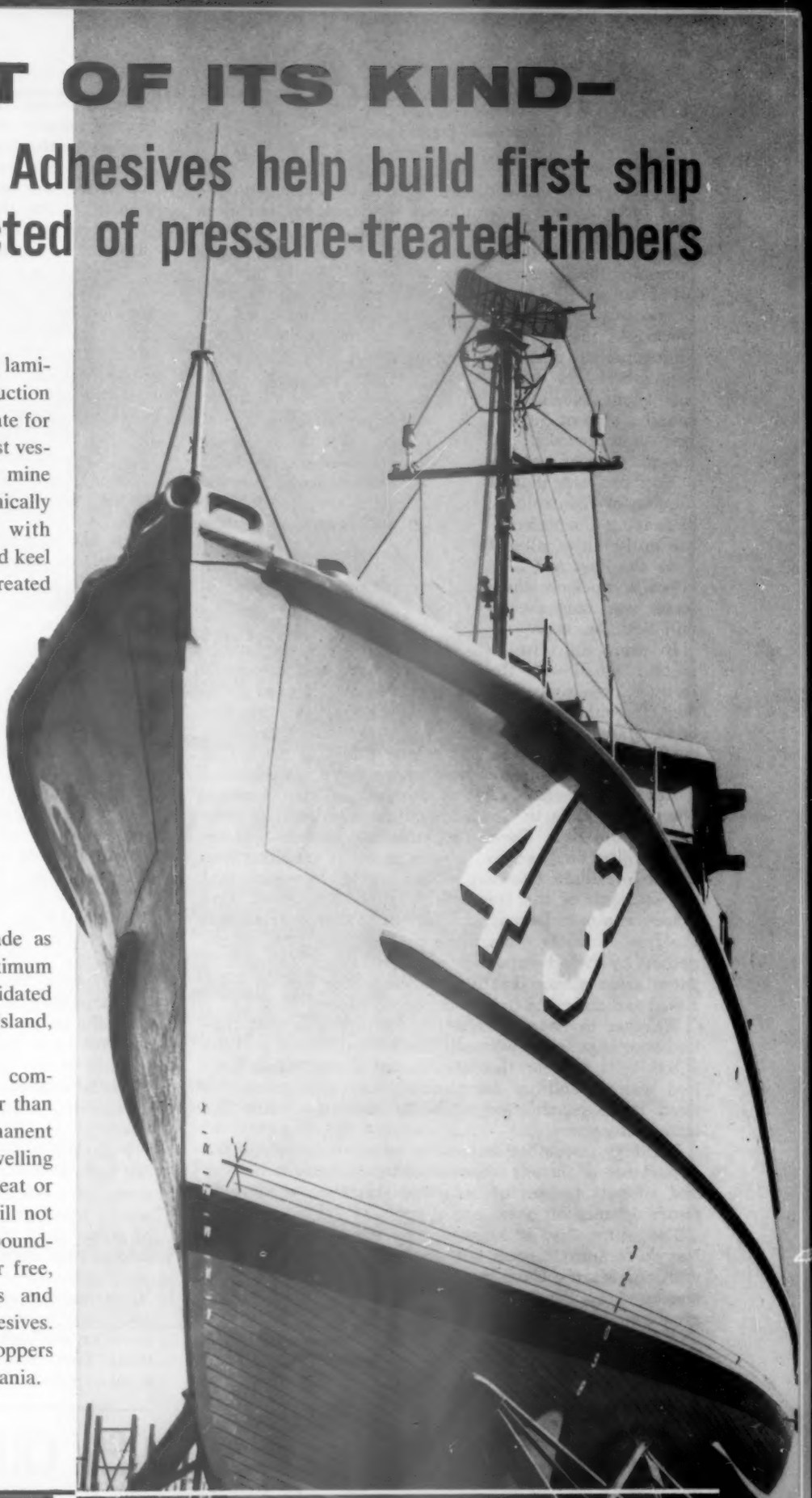

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THE NAVY

(Continued from page 18)

marines carrying the ballistic missile (Polaris). This weapon system will add materially to the nations deterrent force against general war. With seventy per cent of the earth's surface as its stalking ground and the mantle of the sea to cover it, the Polaris submarine possesses the invulnerability we would like to have in all of our weapon systems. A small number can threaten or destroy virtually every fixed land target in the world. At the same time, they can be retained under unquestioned operational control of the U.S. since negotiations for launch sites are not required. While this is an excellent weapon system, I would like to sound a note of caution. Its value is primarily in all-out war—it is useful in limited war only as a deterrent for the purpose of keeping such a war limited.

You can see that, in addition to its time honored mission of "controlling the sea," the Navy, has the job of helping the defense team provide insurance against the outbreak of all-out war.

As the East and West approach a period which is, in effect, a nuclear stalemate, the relative probability of lesser wars and the inducements to keep them limited will both increase.

In using the term limited war, I do not necessarily mean a small war. Rather, it is a war of limited objectives, objectives that would not expand into a global war. It could be nuclear or non-nuclear, its objective is to change—not crush. A limited war is waged with restraint. Neither side drives the other to an act of desperation—or into a corner where there is no escape.

Now let us again look at the role of your modern Navy—this time in limited war. Essentially it is controlling the seas. Controlling the seas means that we can project our national power in many combinations to the maritime frontiers of the world. It means that the strength of the free world can be combined. One glance at a world's map is sufficient to demonstrate that the free world is a maritime confederation, linked together by broad expanses of ocean areas. Control of these areas means that deterrence to war can be ship-based and dispersed in the vast ocean spaces.

Whether or not one subscribes to the idea that limited war is possible between the United States and the U.S.S.R., it is clear that the United States needs limited war capabilities for dealing with aggressors—we need these capabilities in being instantly ready for action anywhere.

Political instability in many areas underscores the importance of instant response and the ability to deliver and support masses of men and machines with minimum reliance on over-seas support.

The autonomy of seapower as exemplified by the Navy's far ranging sea, sea-air, and amphibious forces with our Marine Corps troops provides a means for the measured application of force—from the least to the greatest—adaptable with precision to the demands of any political situation and geography.

We are sure that a war of limited objectives will not be fought in the United States or the U.S.S.R. It will be fought in or over a third country. To help that third country, we must be able to exert our power—limited and discriminating power—on the other side of some ocean if necessary—wherever it is required. We must get it there quickly and get it ashore quickly. We may have to supply it there for a protracted period. We cannot do these things without three capabilities.

First—A capability to control sea routes. Second—A capability to strike within the area of the conflict—to strike with discrimination, and minimum harm on our friends ashore. Third—A capability to put our Marine forces ashore promptly in the area against whatever resistance there may be.

As you can easily see, the first capability, the ability to control the sea, governs whether or not we have the capability for the other two. This was true centuries ago, it is just as true today and will remain so for the foreseeable future.

Now let us examine how the Navy plans to meet the requirements of a future limited war. Our forces will retain characteristics passed down through the years and just as necessary today as in the past—mobility, flexibility and versatility. The shield will still be fashioned out of our defensive antisubmarine forces. The spear is our striking force—carrier air and amphibious—(Navy and Marines). The attack carrier striking force is, and will continue to be for the foreseeable future, the Navy's most effective means for flexible seabased offensive power. It is indispensable for coping with limited war situations, and is one of the country's most effective means of dealing with this type of action.

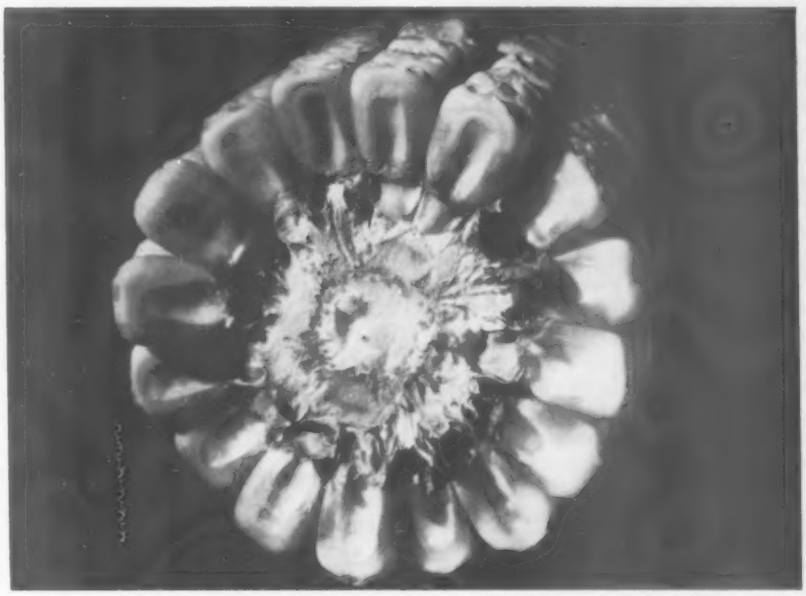
In any war situation, be it all-out or limited, we know that we will face a serious submarine problem. Historically, since its development as an open ocean weapon, the submarine has been a relatively inexpensive and an effective means of disrupting an enemy's seaward extension of his lines of communication. German use of the U-Boat in World Wars I and II, and the feats of our own submarines against Japan, are classic examples. Russia has many submarines. Now that the threat posed by submarines has expanded, it would be fallacious to assume that the Soviet Union is not conscious of the tremendous advantages that accrue from combining recent advances in missiles and nuclear warheads with nuclear powered submarines. As a consequence our antisubmarine forces must be geared to meet a double threat to our shipping and to the continental United States. The Navy is well aware of this threat. Our present antisubmarine weapon systems utilize almost every type of unit in the Navy.

In addition to our carrier attack forces and our antisubmarine warfare forces, we have our amphibious assault forces. These forces can transport our Marines to any trouble point on the globe quickly and efficiently with the help of the attack carrier forces and other support forces as necessary, they can bring quick pressure to bear at any trouble point. We do not need prepared airfields ashore—we bring with us our airfields on the carrier decks and supply our air cover and support from them.

I think it important to emphasize that in limited war the time element is a critical factor. Our reaction time must be quick and timely and—just as important, the action must be discriminating and only to the degree of power that is necessary and no more. Otherwise the limited war with limited objectives could quickly expand into the holocaust of all-out nuclear war. The Navy has forces deployed today that are in position and ready to meet any type of aggression. These forces move on the high seas and do not pose diplomatic questions. They exemplify the Navy's three basic requirements—mobility, flexibility and versatility.

GEN. CREASY TO RETIRE

Announcement has been made of the application of Major General William M. Creasy, Chief Chemical Officer of the Army, for retirement effective August 31, 1958. It is understood he plans to take a position in industry. No successor to General Creasy has been named.



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THE AIR FORCE

Excerpts from address to the Armed Forces Chemical Association at its 13th Annual Meeting at the Traymore Hotel, Atlantic City, N. J., on June 5, 1958, by—

LT. GENERAL WILLIAM H. TUNNER, USAF
Deputy Chief of Staff
Operations
Hqrs. U. S. Air Force

BEYOND the personal pleasure I find in being here, I welcome the opportunity to address this particular group. Your program committee suggested the title "The Air Force Mission in Modern War" and I gladly accepted the suggestion. Certainly there should be a great deal of emphasis on that word "modern." Furthermore, this emphasis should be expected of the scientists and engineers who have done so much to modernize the arts of war.

The accelerating progress of all fields of basic and applied science, in fact, has completely changed war as we once knew it. I believe the best statement of this fact I have heard was made by General Twining when he was Chief of Staff of the Air Force. He said that modern weapons "have not changed the principle of mass in warfare, but they have changed the way in which it is applied. Mass is now applied in megatons, not in manpower."

The contribution of the chemical industries in fuels, propellants, lubricants, refractories, plastics, and alloys has been tremendous to date. We expect it to be even more so in the future. And there is another reason why we of the Air Force value the work of the chemical industry. To a very high degree, since it is serving the needs of a military force-in-being, the chemical industry is in a state of mobilization. It can be considered a part of the combat-ready-force-in-being, with which any possible future war would be fought. You are, therefore, contributing directly to our ability to discharge the Air Force mission in modern war.

When we say mission in this broad sense, we include all of the specific operational areas, together with their supporting activities. Each operational area has its own definite mission, and I should like to discuss some of the more exacting cases.

First, consider the mission of the air defense of the United States. In this age of supersonic aircraft and of ballistic missiles, any defensive set-up established along the geographic border of the United States would be worthless. We share this problem with our great neighbor to the north, the Dominion of Canada. And because of our mutual concern, our two countries have worked out an integrated air defense network, designed to give us the earliest possible warning of impending attack, and to enable us to make the most effective use of the combined defensive resources of both nations.

Detection of unidentified aircraft along the perimeter of our joint defenses is the job of our extensive warning systems. All of you have heard of the DEW Line of radar installations along the Arctic reaches, of the Mid-Canada Line, and of the Pinetree Line, backed up by the Texas Towers, radar picket ships, and patrol aircraft. But you have not heard of the daily level of activity in air defense.

Over a four-month period just ended, our air defense establishment dealt with about 58 unknowns every 24 hours.

This works out to one bogey every 23 minutes. Every effort has to be made to identify the unknown aircraft. During an average day, 33 will be identified without scrambling the interceptors. They will usually turn out to be private aircraft on which no flight plan was received, or which have strayed off their planned courses. In 12 cases, the interceptor will be scrambled and vectored in on the bogey for positive identification. So far, these have always been identified as friendly private, commercial or military aircraft. This leaves an average of 13 sightings daily which remain unidentified. Deep in the defense zones this usually means that a light aircraft has landed and gone out of radar range. However, along the Atlantic perimeter we can always count on a few radar sightings which can be tracked until they are soon to change course and recede beyond radar range. Of course, we class these sightings with those which remain unidentified, although we have no doubts as to whose aircraft they are.

And our air defense forces are always on runway alert in the event enemy penetration appears likely.

The same signal which would put the defensive forces into action would also alert the strategic striking force. In this way, we gain the necessary warning time to get the long-range bombers in the air and on their way if the attack should materialize. Fully one-third of the Strategic Air Command can be put in the air in fifteen minutes, with the remainder of the force becoming airborne over a two-hour period. All would be launched with automatic recall procedures in effect.

According to the situation of the moment, the tactical offensive forces would also be alerted, according to the needs of whichever theater commanders might be dominant.

And the air transport and logistics necessary to carry out the immediate battle requirements would be ready for use. All of the resources of the Military Air Transport Service, of which I will assume command next month, have been allocated specific wartime tasks by the Joint Chiefs of Staff. Within a matter of hours, the necessary combat support would be functioning smoothly.

For situations of more than local scope; that is, for all-out global war, the military air fleet would be supplemented by the Civil Reserve Air Fleet, composed of the aircraft of the air lines of the United States. We work very closely with the air lines and other Government agencies in planning for the requirements which might be levied upon them under conditions of full mobilization.

One aspect of airlift, which you as industrialists will appreciate, relates to the economies it offers us. We have worked out a plan of airlift for costly, high-priority supply items which makes it unnecessary to tie up millions of dollars in depot inventory. We now move them direct from supplier to user. The cost of airlift is saved many times over in the lower inventories. And this will be especially beneficial in the missile age.

Consider the complexity of moving the intercontinental ballistic missile, ATLAS, from the factory to the launching site. When ATLAS leaves the assembly line, it is a very odd bit of hardware. Here we have a single weapon 80 feet long and 9 feet in diameter, weighing 195,000 pounds when loaded for launching. And while we do not haul it with fuel aboard, of course, it requires much the same sort of care as a living creature would. Certain of its components, for example, must be kept at a constant temperature, either by heating or by air conditioning. And huge sections of the missile must be kept under constant air pressure. Yet, we can move them by air. To do this, we have built a specially-designed trailer which receives it from the

assembly line and takes care of it during travel. The trailer and missile can be loaded as a unit aboard the C-133 aircraft and flown to the launching site.

And, I should like to add, what we do for ATLAS we can do for every other weapon system we have.

So far, we have looked at just a few of the specific missions of operational segments of the Air Force. All of these missions are closely inter-related .

In time of war, these missions would be executed in such a manner as to assure the earliest possible decision for victory.

For a few moments, I want to discuss these missions in terms of our reaction to the threat.

The question which arises, of course, is the manner in which we might learn of enemy intentions.

In the Air Force, we consider that the present international situation is actually a period of strategic warning. This is our interpretation of the Soviet military build-up. A nation which pours such a disproportionate share of its national effort into long-range aircraft, nuclear weapons, and missiles, at the marked expense of consumer goods and the welfare of its people, certainly has a reason for doing so. The intensive propaganda offensive being waged against the United States by communists in all parts of the world indicates that we are their principal stumbling block on their path to world domination.

So, with this view of our present state of strategic warning, we anticipate that our true warning may well be tactical. That is, it may well come as a surprise move.

It is an undeniable fact that our declared national policy of non-aggression concedes the military advantage of surprise to the enemy. The overt act itself, the stab of aggression, therefore, could be our tactical warning.

Now, this stab could come as a sudden thrust against some point in the NATO area. It might come as an eruption against some SEATO nation. It might come within the Baghdad Pact area of the Middle East. In either case the Soviets would certainly risk retaliation by our forces against their own homeland; certainly too high a price to pay for the risk of limited gain. So we see the greatest military probability as swift and massive air strikes against American offensive airpower, simply because this is the only military force of the free world capable of inflicting immediate and decisive damage through the length and breadth of the Soviet land mass.

We also believe that the very existence of such a force, coupled with our declared intention to use it if we have to, is the best guarantee that no major war will occur. Wars are started with the expectation of gain; by denying any possibility of gain, we have made war itself a broken tool, so far as the settlement of international differences is concerned. This is what we mean by deterrent force.

The thing that makes the deterrent force work is the power for victory we have built into it; a power to be used if deterrence should fail.

In this eventuality, what would be our reaction?

First, let's consider our reaction in terms of time and mass. Such reaction is a function of force deployment and the state of readiness.

The dispersal of the long-range striking force of the Strategic Air Command is moving ahead at an accelerated rate. Briefly, dispersal does two things. By housing no more than one squadron of heavy bombers on a single base, for example, we multiply the problem of the would-be attacker by making it impossible for him to knock out the force on the ground. We also make it possible to get more aircraft into the air on

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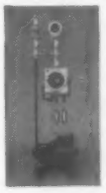

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short notice. You can launch three times as many bombers from three runways in a given time than you can launch from one.

Furthermore, dispersal vastly enhances the size of the strike force we can keep on runway alert. It is not generally known or appreciated, but what I said a few moments ago about getting this force airborne in a matter of minutes means that we are now able to scramble the long-range bombers just as we scramble the interceptors of the defense forces.

Finally, with specific targets assigned to each bomber crew, and weapons available in whatever size is needed for the destruction of these targets, we have the deployed force with firepower for victory, ready for instant use.

Reaction in terms of sequence of events could very easily follow one of the anticipated patterns.

Assume, for example, that the blips on a radar scope along the DEW Line *did* materialize as an enemy attack. The alert signal flashed to the NORAD command post for defense would, as we have seen, also get the long-range bombers in the air. The alert signal would go to the headquarters of the Air Force, and to the Joint Chiefs of Staff, the Secretary of Defense, and the President.

We would, therefore, be in action within minutes.

The defensive system would be tracking the incoming aircraft. Defense controllers would vector the interceptors, armed and ready, along the interception path. The bombers would be launched on their way, *but with a most important precaution.*

This precaution we call "POSITIVE CONTROL."

There is a certain geographical line beyond which our bombers may not fly, even under actual launch orders, unless they receive confirming orders to proceed to target. This simple expedient is our protection against being tricked into starting the war. Failure of a radio, or any other malfunction of communication cannot trigger the attack, since the bomber commander will not fly past POSITIVE CONTROL without *positive and verified orders to do so.*

Therefore, with both defensive and offensive elements in operation, the situation as it develops is under the constant evaluation of the Commander-in-Chief and his agents. Once the enemy intention were found to be clearly hostile, the strike order could be issued. This strike order, by the way, will shortly include the missile delivery systems.

At this point, our estimate of the situation would be based upon the size, speed, and direction of the attacking forces. As things stand now, the odds for success favor the attacking force. There will be some attrition exacted from the attacker. However, in this age of nuclear weapons, if the defenses knocked down three out of four bombers in a flight of four hundred, we should still suffer the damage of some nuclear weapons.

The same advantages, however, would be in favor of our forces as they penetrated the enemy perimeter.

In such a war, gentlemen, the proof phase would be very short. I use the term "proof phase" because we are now in the *decisive phase of warfare.* What we do today to keep our strength clearly and convincingly capable of victory is decisive. If the shooting ever starts, it will only prove who made the right decisions.

So far, we have looked only at the maximum situation of global nuclear war. There are certain characteristics of the so-called small-war situation we should always remember.

There is only one area of the world where we find an armed enmity toward the United States. This is the area of communist domination. Therefore, any small

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THE ARMY

(Continued from page 17)

tical mobility and increased mechanization of the logistics system will be needed. Rapidity of offensive reaction must stem not only from an increased mobility and streamlined command echelon, but also from the ability of small battle groups to operate independently for long periods over great distances. They must be able to live dispersed and to concentrate rapidly to fight. More mobile land vehicles will be necessary. Aircraft and triphibious units will move over any type of terrain.

In order to implement new tactical concepts, dictated by this atomic age, there must be significant advances in many material areas.

The Army's arsenal of weapons will increase in power and adaptability. Development of medium and low yield tactical atomic weapons must be continued to meet the demands of faster moving and dispersed tactics. Development in the chemical and biological field must assure us that we are prepared for their use and their far reaching possibilities. What future conflicts, and we hope there will be none, will demand for survival and victory, undoubtedly surpass the imagination. They have in past wars.

The Army is developing warheads for our missiles which will provide a selective capability for destroying a variety of targets. This selectivity will vastly increase our flexibility and provide the means for effectively attacking targets of every type. These second generation missiles, the children of sturdy stock, represent improved capacities for performance in every respect. They will shoot further and more accurately. Ease of handling, greater safety for troops, and time saved by elimination of the fueling operations will result from solid propellants in place of liquid fuels. These new missiles will enable higher firing rates, greater mobility, and a large reduction in equipment now required for liquid fuel. Our aim is the development of guided missiles which will be as simple as possible.

The need to move rapidly will be a tactical necessity on the future battlefield. Specifically, Army forces must be provided the ground and air mobility required to enable them to enter combat rapidly at a point of their own choosing. This requires major improvements in two fields; first, we need lightweight armored and air transportable vehicles with true cross-country mobility which provide protection and speed of movement; second, we need improved air vehicles which are low flying and capable of vertical or short take-off and landing. Such air vehicles are just ground transportation designed to avoid obstacles.

Communications provide the means to control units and weapons. They are the nerve system that provides the ability to react. The better they are, the faster the reaction, and they must operate under any conditions of weather day and night.

Before closing, we should note the basic element of this organization and which we must weigh properly along with tactics and hardware. That is the individual —our officers and soldiers. The Army, as well as the other services, will be no better than the people in it. We need personnel of the highest quality to meet the increasingly complex demands of leadership and modern warfare.

There is a misconception that atomic and other modern weapons can replace ground forces. This is not the case.

ANNUAL MEETING

(Continued from page 11)

affair. Again the Association this year was indebted to Mr. King George Irving, president of the Dallas Chapter, for his annual contribution from Tyler, Texas, of forty dozen Texas roses. Photographs of the meeting were taken by Pfc. Horace Rosenthal, U.S. Army Signal Corps, Fort Monmouth, N.J.

There were fourteen at head table for the banquet, from left to right as follows:

Mr. Henry T. Clark, President of Wilmington, Del., Chapter of A.F.C.A.

Brig. General Harold Walmsley, Commander, Army Chemical Center, Md.

Brig. General John A. Heintges, Army Training Center, Fort Dix, N.J.

Brig. General J. L. Person, Corps of Engineers, Washington, D.C.

Maj. General Bell, Commanding General, II Corps, Camp Kilmer, N.J.

Brig. General Clifford L. Sayre, President-elect of A.F.C.A.

Lieut. General Arthur G. Trudeau, Chief of Research & Development, U. S. Army, Washington, D.C.

Mr. Glenn A. Hutt, Outgoing President of A.F.C.A.—Presiding.

Maj. General William M. Creasy, Chief Chemical Officer, U. S. Army, Washington, D. C.

Maj. General Silas B. Hays, The Surgeon General of the Army, Washington, D.C.

Brig. General Marshall Stubbs, Commanding General, 1st Logistical Command, Fort Bragg, N.C.

Brig. General A. F. Cassevant, Comandant, Army Signal Corps School, Fort Monmouth, N.J.

Brig. General Robert C. Tripp, Transportation Corps, Washington, D.C.

Mr. James Sheridan, President New York Chapter of A.F.C.A.

Col. Donald F. Grothaus, Commanding Officer, Ft. Detrick, Md., receives on behalf of the Post, A.F.C.A.'s bronze safety award plaque presented by President Hutt at meeting at Atlantic City, June 6.

THE AIR FORCE

(Continued from page 24)

war which might involve the United States would also involve a proxy nation of the Soviet Union. Therefore, such a small war would contain the seeds of global conflict. It would have to be dealt with in such a way as to contain it; to limit it in space and time. This means we must use all the speed of mobility, and the flexibility of forces, which characterize modern airpower. And it logically follows that any force capable of dealing with all-out war on a global scale has within it the elements needed to deal with lesser, local situations.

In closing, I should like to remind you that by reason of the fact that each operational area of the Air Force is prepared to discharge its mission responsibility, we have created a deterrent force. This force is the instrument of our national policy of the prevention of war. We have no imperialistic ambitions. We do not seek to dominate other peoples. We are not, and we never have been, a militaristic nation.

But, by the same token, we do not intend to become the victims of aggressors. We certainly do not intend to be dominated by a foreign power. We ask only to be left alone to work out our destiny.

As of now, we see clearly that, in order to work out our destiny, we must for the foreseeable future maintain an adequate strength to insure our survival and to insure the peace of ourselves and the free world. In broad terms, we see this as the "Air Force Mission in Modern War."

2 A.F.C.A. GROUPS ACTIVE IN NATO SUPPORT

Six Edgewood, Maryland, High School students will have a three-day, all-expenses-paid visit this September as a reward for their winning entries in a recently completed "What NATO Means To Me" essay contest, co-sponsored by the New England and the Chesapeake Chapters of Armed Forces Chemical Association.

The winners, each provided with a special certificate, are pictured here with Col. Dominic J. Chiminiello, executive vice president of Chesapeake Chapter. On the left of Colonel Chiminiello are Budne Reinke, Carol Baker and Nancy Hinckley. On his right are Susan Fisher, Bill English, and Bruce McCommons.

The basis for this activity in respect to NATO is special interest taken by these Chapters in the forthcoming meeting in Boston, September 21 to 28, of the Atlantic Treaty Association. The Association consists of national voluntary organizations in NATO countries which support the Atlantic Treaty. Its purposes are to educate and inform the public concerning NATO; to conduct research in fields related to NATO objectives; to promote solidarity of peoples of the NATO area and cooperation between member organizations.

Joint hosts for the program in Boston this year are the Boston Regional Conference on NATO Affairs, Inc., of which Mr. Harry A. Wansker, president of the New England Chapter, is president, and the American Council of NATO, Inc.

The New England Chapter is also financing a visit of a similar group of high school students selected from the Boston area.

THE TECHNICAL SERVICES OF THE ARMY

Following, in order of presentation, are excerpts from the ten addresses by the Chiefs, or their representatives, of the seven Technical Services of the Army, respectively, at the June 6 session of the 13th Annual Meeting of Armed Forces Chemical Association, at Traymore Hotel, Atlantic City, N. J., June 5-6, 1958.

CHEMICAL

MAJOR GENERAL WM. M. CREASY

Chief Chemical Officer

A GREAT amount of effort has been expended in the last few years on the reorganization of our combat forces necessitated by the advent of atomic and thermonuclear weapons. Future disposition of troops and their employment in combat will be based on the premise that such weapons may be used by the enemy notwithstanding any agreements which might prohibit their use. Under such circumstances, therefore, possible targets for large nuclear weapons will be difficult to find on the battlefields of the future.

National policy favors the development and possession of nuclear weapons as a deterrent. However, the tremendous forces unleashed with the detonation of nuclear devices cannot help but make one consider the very serious questions: "Will these weapons be used in war? With the U. S. in possession of nuclear sufficiency, would an atomic attack on the U. S. be profitable to any aggressor?"

Short of nuclear weapons, what worthwhile weapons systems would be available for use with present and anticipated airplanes and missiles? Would both sides go back to high explosives alone?

These are questions which we and any enemy must answer. We must be aware that an enemy may decide to use chemical, biological, and radiological weapons against us. I do not believe that an enemy bent upon total annihilation of the forces of democracy would hesitate to exploit to the full the potentialities of this method of warfare.

Mr. C. H. Carter of Atlas Powder, Wilmington Chapter, presides at morning session June 6.

It is not too difficult to see how an enemy bent on aggression might react when confronted with a foe equal to himself in weapons, training, and firepower, fully equal in the ability to trade blow for blow in nuclear warfare. Faced with tremendously reduced possibilities for a quick knockout in a head-on clash of forces, would he feel bound by any considerations, moral or otherwise, concerning the use of the CBR weapons? Or would he choose an alternate method which could very well accomplish his purpose?

I do not believe that any great clairvoyant powers are required to arrive at an answer. Whether or not we can be sure of the answer, we cannot say that we are doing everything possible in building our defenses until we have included in those defenses adequate capability in CBR warfare.

To those who may have doubts as to the validity of concern over our posture in this area, I believe it would be well to take fresh stock of the characteristics of the chemical and biological weapons, and why they might be attractive to an enemy. And we should keep in mind that such an attraction might hold even though a war involved the use of nuclear weapons. It is well to remember that a combination of nuclear weapons and the chemical and biological weapons could wreak havoc beyond the powers of the imagination.

The use of nuclear weapons, with or without CBR, would depend largely upon what the enemy hoped to achieve, whether he wanted to bring about utter destruction or merely to incapacitate a people.

Military attacks are not necessarily undertaken to destroy, but to occupy territory for which the occupier foresees a use.

World War II was the most costly and destructive conflict in history. More than 52 million people were

killed or injured—more than half of them civilians. The belligerent nations spent more than a trillion dollars on armaments and war materials. The other material costs were immeasurable. We know only too well what it cost to rebuild destroyed nations.

From this, the reason why CBR weapons may well appeal to an aggressor is not obscure. The use of nuclear weapons on an indiscriminate basis would destroy facilities which were the object of an enemy's aggression, or at least render them worthless for postwar use. To make his aggression worthwhile, these highly coveted productive facilities would have to be reasonably intact at the end of hostilities.

To achieve this result, the enemy could use CBR munitions which would attack only people. By causing death or merely debilitating illnesses among industrial workers, their productive capacity would be lost or severely limited. And with this decrease in production, the free world's armed forces would soon become seriously weakened through the lack of munitions, equipment, food, and medical supplies.

In addition, it is quite conceivable that an enemy would consider the need for captive labor to man the factories he has captured intact. Nuclear munitions would kill or maim great numbers of people, rendering them of little use in the postwar economy.

But through the use of specific chemical, biological or radiological agents, the enemy might seek to make industrial personnel so ill that they could not work for long intervals of time during the period of combat—but leave them available as a manpower supply later on.

This is a most significant feature of CBR weapons. They are agents of minimum destruction in that they themselves do not cause destruction of facilities but instead attack the people who operate the facilities. Further, the degree of their effect upon people can be controlled. The advantages of this important fact to the plans of an aggressor can readily be seen.

But there is still another consideration which might be equally, if perhaps not more, tempting. This would be the fact that, through the use of CBR warfare, an enemy's own losses might be considerably reduced.

The United States did not use this type of warfare in World War II. At the outset of that conflict, we announced that chemical warfare would be used only in retaliation for similar attacks upon ourselves.

It would appear highly unlikely, however, that a future aggressor would give us that advantage. We have ample warning by potential enemies that planning for the next war includes the possible use of CBR weapons.

We must not lose sight of still another military advantage factor in the use of such weapons which might well appeal to an aggressor nation—namely their effectiveness. United States casualties in World War I showed that a man wounded by gas had a four times better chance of survival than did a man hit by flying lead or steel. An aggressor might well consider that this causes a drain upon manpower reserves, since a nonfatal casualty needs five or six people to care for him during the convalescent period, while a dead person is no such liability. The reserve-depleting effect could be achieved whether chemical, biological or radiological agents were employed.

One final—and vastly important—advantage factor in the use of CBR warfare which might appeal to an aggressor nation or bloc is the fact that the utilization of various agents in the field permits the covering of large areas to military advantage with a minimum logistical effort. This means greatly reduced expenditures of material and industrial resources.

A look at the chemical weapons now available make clear their potentialities. Those who know nothing about the war gases, or have only vague knowledge concerning them, think of them as strangling pain-producing horrors.

Actually, however, among the most painful of war gasses are those which are used for harassing effect and which do not cause actual battle casualties. An example would be tear gas, which is employed for riot control. Its effect passes off within an hour or so.

Of the real casualty-producing agents, the three principal types are the vesicants or skin-burning agents, the lung irritants and systemic poisons. Mustard gas is a vesicant, while the phosgene is an example of a lung irritant.

Nerve gases are examples of the systemic poisons. They were discovered by the Germans during World War II in the course of research designed to develop improved insecticides. The Wehrmacht had quantities of nerve gas stored and ready for use during that war.

We must be constantly on the search for newer and even more effective agents in the CBR field, for we can rest assured that we are not alone in our knowledge of the potentialities of such weapons. As in all other areas of warfare, much of our strength must come from technological supremacy in the development of newer and more effective weapons which will act as a deterrent on an enemy's will to start a war. This must be a continuing race, for supremacy can be a short-lived thing. And it is by no means a one-sided race, for we have had ample evidence of Soviet capabilities in the field of science.

In the realm of biological warfare—the deliberate use of micro-organisms—an enemy has at his command a weapon of great variety and flexibility. By careful selection from the many diseases which can affect man, and his food, both vegetable and animal, he can achieve almost any desired effect. If it is his wish merely to incapacitate for short periods of time, this can be done by proper choice of his agent. Or, he may choose a plague which will wipe out troops or people.

Biological warfare weapons have unique potentialities which could very well make them most attractive to an enemy bent upon subjugation but not total destruction.

For example, he could strike at the heart of industrial capability by not only incapacitating the workers directly in the plant but through communication and transportation systems, and food supplies. It is an effective weapon for use far behind the lines in an enemy's heartland where the goods and materials of warfare must be produced.

It also is an effective weapon for sabotage. Death blows could be struck at an adversary's capacity to wage a war without his being aware that such an attack had taken place until the damage was done. It can be made to strike at targets not readily accessible to weapons of other types.

The very nature of biological warfare gives an aggressor nation great flexibility in methods of delivery. Effective employment is possible by means ranging from use by saboteurs against selected installations to mass delivery over large areas by airplanes, submarines, and missiles.

Communities are particularly vulnerable to attack by the biological weapons, particularly those in and around industrial areas. It is not difficult to visualize the crippling capacity of a well planned and concentrated BW attack on a city. Agents could be distributed through food supplies, especially through processing centers, through the air conditioning systems of buildings and factories. We have had many examples of what happens when workers are kept away from their jobs—such as the snow storms we had in the East last winter. Not only are workers kept away from their jobs, but trans-

portation breaks down, delivery of food supplies, fuel,—the many services which we depend upon, break down.

This effect could be achieved even more effectively by disease agents than by snow, with effects spreading over weeks or months, rather than a few days.

I am not saying these things to cause alarm, but I am saying them to awaken our people to dangers which have not been too well visualized. If they are apparent to us, they are even more apparent to an enemy.

The Army Chemical Corps, as you so well know, is intimately and daily concerned with these things. We are concerned not only with the methods by which we may achieve a capability in these areas strong enough to discourage their use by an enemy, but we are concerned with developing the means of defense against them. We are concerned with lack of public awareness of these dangers and the lack of sufficient public interest in the actions which must be taken to make it possible for us to survive as a nation and as a people should we be faced with a CBR attack.

I have not gone into any detail as to the "R" portion of CBR in my talk, but it must be considered along with chemical and biological methods of warfare. Radiological warfare encompasses attack on personnel by means of radioactive agents. This may be the result of fallout caused by the burst of nuclear weapons, or it may result from distribution of radioactive material by other means, such as by small bombs dropped from planes or missiles. With the latter system there would be little or no attendant destruction of facilities.

With this type of warfare, an enemy could cause short or long term contamination and denial of large areas, depending on the means of contamination and the material employed. And a similar control could be exercised in regard to troops and populations in those areas—whether to kill or merely incapacitate.

The Army Chemical Corps has made a number of advances during the year, both in achieving a capability in warfare and in the means of protecting our troops against the CBR agents. I should add, parenthetically, that we give wholehearted cooperation to Civil Defense people, by making available to them knowledge gained from our developments, and by assisting them in adapting protective devices and measures for civil use.

As a final word:—If there is any doubt in anyone's mind as to why we must be seriously concerned with our capability in chemical and biological warfare I refer them to a statement which appeared in the April issue of a newsletter from NATO: "They (the Soviets) are capable of waging biological and chemical warfare on a large scale."

CHEMICAL

COLONEL RONALD L. MARTIN
Deputy Commander Research and Development Command
Office of the Chief Chemical Officer

I WILL divide the material which follows into the three broad areas of Chemical, Biological and Radiological warfare. I am sure that this group will recognize that security considerations somewhat limit my discussion.

In the area of Chemical Warfare, flame warfare plays an effective role. The use of flame was exploited during World War II as an effective and demoralizing adjunct in battlefield combat operations. This field reached a high degree of perfection by the end of the war with the development of portable flame throwers, tank flame throwers and the very important aerial napalm bombs which were used so extensively in the bombings of Japan. The war in Korea however, highlighted certain short-comings, such as range, weight and silhouette in the portable flame throwers. We have corrected those deficiencies and, in conjunction with an industrial concern, have recently produced a lightweight portable one-shot flamethrower. This flamethrower is considered to be particularly useful for the reduction of bunkers and other emplaced positions where high explosives are not effective. When equipped with a remote firing device, it has been found suitable for use in defensive situations. It may also be adapted as a booby trap.

As for new Chemical Warfare agents, we are continually investigating the mechanism of action and applicability of potential compounds whose properties vary considerably. Recent specific developments in this area, which I cannot discuss for obvious reasons, reflect but one prong of a varied attack in our search for new agents. Although some of these agents are necessarily lethal, we have also vigorously investigated other agents which can be used to temporarily incapacitate. The advantages inherent in this type of an approach are widely recognized. I am sure that you have all read with interest the various reports by medical investigators on the effects of these chemicals, knowns as psychochemical agents, on the human organism. The feasibility of adapting these agents for military operations is being vigorously investigated. Naturally, we have not been limited in our investigations to work on just these chemicals.

In cooperation with the Air Force, the Chemical Warfare Laboratories are developing new methods for laying down smoke curtains for the concealment of paratroop jumps and other combat operations. A new smoke tank for use with modern aircraft has been developed which exploits a new technique for producing a cloud

free of the gaps and rifts common to other screens. It can form a complete curtain from 500 feet in the air to the ground in about 25 seconds, as compared to from 5 to 25 minutes for previous types. The result is a high and solid, or "vertical" curtain from plane to ground.

We have also recently developed a new type irritant gas disperser which can be used to cope with any variety of riots or disturbances. This device is capable, under normal conditions, of blanketing an area of several city blocks with controlled quantities of tear gas or nauseous-type irritant. It can be mounted on trucks and rapidly transported to the scene of a disturbance. This item could very well be of importance for coping with mob riots.

In the area of defensive equipment, it was recently announced in the newspapers that the Chemical Corps, with the assistance of an industrial concern, had developed a revolutionary type of protective mask. A distinguishing feature of this mask is the fact that it is canisterless with aerosol gas filter pads used at the cheek positions. All previous masks have had protruding and bulky canisters which at times have interfered with the combat actions of the soldier. The mask is designed to give the soldier complete protection against the inhalation of war gases, germ warfare agents, and airborne radioactive fallout particles. It has many important advantages over types now in use; such as lower breathing resistance, superior vision, better speech transmission, and greater comfort. Pending some minor modifications, it is expected to standardize this item in the not too distant future.

In the area of detection of chemical agents, we are developing a new device intended for use by troops in the field. The new device, known as LOPAIR, will flash a warning light and sound a horn when a tiny amount of contaminant in the air crosses an invisible infrared beam. This is an extremely sensitive device and will detect contaminants even though they are colorless and invisible to the naked eye. In combat, it would warn the soldiers to put on their protective masks well in advance of an oncoming gas cloud. Our scientists feel that there is also a peace-time application for this item since it can be used in air pollution studies and in the detection of various industrial chemicals necessarily present in certain types of industrial establishments.

The next major area, Biological Warfare, possesses great potential and flexibility. The proper choice of organism can lead to almost any desired effect; from a minor incapacitation to a lethality.

It is the obvious and proper goal of biological warfare research to have an agent which would possess sufficient viability, virulence, and stability to meet realistic minimal logistic requirements, and to be capable of being disseminated without excessive destruction. Our efforts in this area are showing remarkable progress.

In an all-out biological attack on a heavily populated city, detection is a critical problem. BW agents have no characteristics detectable by the senses. They are invisible, odorless and tasteless. Therefore, rapid detection becomes imperative. Chemical Corps personnel at Fort Detrick are working on an extensive program for rapid laboratory diagnostic methods.

In the area of vaccines, research workers at our Biological Warfare Laboratories in conjunction with Department of Agriculture investigators recently developed a vaccine for Rinderpest, a rapidly spreading, highly fatal, disease of cattle and sheep. On the one occasion when the disease was accidently introduced into this country, the slaughter of entire herds was necessary for its eradication. The availability of this effective vaccine does much to eliminate the potential danger of this type of biological attack.

Another vaccine in which we in the Chemical Corps take pride has been the development of the first non-living anthrax vaccine acceptable for tests in human beings. The original vaccine developed by Louis Pasteur in 1881 for cattle and sheep, and essentially the same vaccine used at the present time, cannot be used in man. Research effort by our scientists on this organism has resulted in the production of a stable preparation of a vaccine for anthrax available for practical use. This preparation has been shown to be effective in a variety of experimental animals. In tests involving humans, it has been found to produce no toxic effects. This vaccine is at present under tests involving the immunization of industrial workers in industrial plants where this organism is a hazard.

Our biological scientists have, for several years, been interested in developing combinations of vaccines that might be needed in the event of a BW attack. At present, the Chemical Corps has turned over the evaluation of the applicability of this multiple-vaccine program to The Army Surgeon General.

Some two months ago, scientists from Fort Detrick reported to the Society of American Bacteriologists in Chicago that they had developed a combined toxoid to combat all five known types of botulinum poisoning. The disease readily occurs in persons who eat improperly canned foods which have become contaminated, with death resulting in 40 to 50 percent of the cases. In addition, the disease often strikes animals—sometimes in epidemic proportions.

A few weeks earlier, our scientists reported the development of a gaseous sterilant for disinfection of infectious laboratories and rooms. The agent used is Beta-Propiolactone—manufactured under patent by the Celanese Corporation of America. This discovery has been widely publicized. This sterilant is now being called for by some of our commercial establishments, where laboratories, switching from one type of infectious work to another, must be thoroughly sterilized to destroy infectious organisms. We have found this sterilant extremely valuable in the disinfection of laboratories and other areas, as well as of delicate equipment. Its value to hospitals can readily be seen.

If warning were given of an imminent CBR attack, there are physical means of protection available that are very effective. The present military and civilian protective masks have excellent filtration efficiencies. Commercially produced air filters with adequate filtration efficiencies are available for shelter areas. A diffusion board made of fiber impregnated with activated charcoal, looking much like ordinary wallboard, has been developed that may be used for shelter walls. This allows diffusion of moisture and air but filters out organisms and radioactive dusts, and has significant gas-arresting properties.

In the radiological field, the Chemical Corps is charged with the responsibility of perfecting devices and techniques for protection against, and detection of, radioactive contamination. We have already mentioned the use of the canisterless gas mask as a device for protection against airborne radioactive particles. In addition, we are developing a gamma-neutron dosimeter so that our soldiers in the field will know when they are entering a contaminated area or how much radioactivity they have been exposed to. This device is a self-indicating tactical device which responds to both gamma and neutron radiation and may be adjusted to respond to neutrons in the same ratio as the human body. Development of this device will satisfy the indi-

(Continued on page 43)

QUARTERMASTER

MAJOR GENERAL A. T. MCNAMARA
The Quartermaster General
Address was delivered for Gen. McNamara by

COLONEL JOHN D. MARTZ, JR.
Chief Research and Engineering Division
Office of the Quartermaster General ➔

THE Quartermaster Corps has been able to develop and maintain a broad range of talent in the research field. And it is through the successful efforts of these experts that we have been able to produce, first the ideas, and finally the end items to keep pace with the demands of the Modern Army.

Quartermaster items, relatively are neither glamorous nor dramatic. At least, not as compared with developments in the fields of planes and missiles and atomic submarines. But they are just as vital to our national defense. And bringing them into being takes just as much technological ability and effort.

For example today in our laboratories we are conducting research on improved materials for body armor, on chemical resistant rubbers which will remain flexible in extreme temperatures, on the mechanism of energy dissipation as applied to air-dropping of supplies, on the chemistry of food flavors, and on the use of ionizing radiation in the modification of textiles and other materials.

To the average man-in-the-street, even to the average military man, these hardly sound like world-shaking projects. But to those concerned with developing the necessary equipment and supplies for the Modern Army, they are just as vital and essential as Sputniks and Explorers. And, to the scientists and technologists working on them they can be just as exciting.

I am proud to say we now have an excellent research organization under Quartermaster Corps control. And I am very happy to say the importance of maintaining this Quartermaster research organization is widely appreciated.

It seems almost unnecessary to say this, but I foresee the possibility that, with technological and scientific advances occupying so much of our attention, we may overlook the fact that in the final analysis the military observer, not the technical man, is the only person who can uncover and define the problems of the military user. This does not minimize, however, the role of the technical man, nor of the man in industry, in meeting the military needs of today and tomorrow. It only emphasizes the fact that we can never get very far away from military applications.

Those of you in industry are by no means unaware of military implications and have assisted the military toward their objectives in many ways. The know-how of industry has been made available to us without restraint, and many stubborn problems have been worked out through industry cooperation. Industry members have served unselfishly and at their own expense on our Industry Advisory Committees. These committees have been of great service to us.

This fine meeting today is an outstanding instance of a major gathering together of industry people and military people with many of the same common interests. It is because of these mutual interests—and our mutual concern with National Defense—that it gives me so much pleasure to address you today. We need such meetings as this to bring us all to a better understanding of each others contributions and problems.

I need hardly add that the Quartermaster Corps depends upon the chemical industry for a vital portion of its supplies and that we must rely upon your industry to support our research and development programs in this field. I could not begin to list our requirements for chemicals and plastics, nor the advances we have made, with the aid of your industry, in applying the latest developments in chemistry to the benefit of the soldier. These applications extend across virtually every one of our supply categories, including food, clothing, shelter, petroleum handling, and mobile equipment. Thanks in large degree to chemistry, and the progress which you people have made in your science, our supplies are so superior to what they were a few years ago as to be beyond comparison.

I started out by saying that some things in this changing world should remain anchored. I specified the spirit of cooperation that our military-industry relationships have fostered. Without that spirit we could never have accomplished the near-miracles of the past. Without that spirit we shall not be able to meet the wave—the tidal wave—of the future.

Lest you think that I am indulging in mere oratory, let me conclude by reminding you that we are now in the opening stages of the "space era." What lies above and beyond we have not figured out as yet. Among the problems of this new era will be supply problems, and feeding problems. To paraphrase William Shakespeare: "There are supply problems ahead that you and I in our present philosophy wot not of." We shall need, as we approach those unknowns, courage, ever sharper objectives, a consolidation of our technical and talent resources, and, above all, the continuation of our habit of working successfully together.

Now I have been wielding a pretty broad brush for the past 10 minutes. I don't mean to imply that the Quartermaster Corps doesn't deal in specifics. I have purposely controlled my enthusiasm for those details, however, because I want to leave them to one of our experts. I have asked Mr. Charles N. Gardner, Chief of the Development Branch of our Research and Engineering Division, to take over the platform at this point.

QUARTERMASTER

Mr. C.N. Gardner
Chief, Development Branch
Research and Engineering Division
Office of the Quartermaster General

OUR principal client is the *individual* combat soldier and our prime job is to enhance his combat performance on the battlefield.

FEEDING TOMORROW'S ARMY

Highly mobile, widely dispersed fighting units cannot be tied to a long drawn out logistical tail associated with the conventional feeding system—with its skilled cooks, kitchen equipment, refrigeration facilities and time-consuming food preparation and distribution activities. We have evolved, therefore, a new field feeding concept which will give us a variety of tasteful nutritious meals; and reductions in—food service personnel; equipment needs; volume; weight and, supply operations.

Combat feeding of perishables will no longer be limited to special holidays. Monotony in diet will be minimized since meals of high acceptability and diversification will be provided. Precooked dehydrated meals will not require quantities of water to clean mess gear. Although water will be needed for reconstitution, total water needs will be less than the present consumption. Fuel savings as well as economies in transport will be bonus advantages. Refrigeration requirements will be greatly reduced.

The new meals, as presently envisioned, will be:

a. Meal, Uncooked 25-Man Primarily intended for rear area troops, consists of uncooked foods preserved chiefly by dehydration and radiation.

b. Quick Service Meals (25 and 5 Man) Will find their greatest employment in areas where facilities for food preparation are limited. They can be prepared by a soldier with no specialized training.

c. Meal, Ready-to-Eat Individual—This meal is especially designed to meet the most difficult of all feeding situations, where the individual is in close contact with the enemy. Dehydration and irradiation will make possible a nutritional variety and balance never before attainable under such extreme conditions. A typical breakfast menu may include irradiated orange slices, irradiated ham slices, bread roll, pecan roll, jam, instant coffee, sugar, dry cream and non-fat instant dry milk.

Although the introduction of this new feeding concept is still several years off, we are well along in development and are planning tests at CONARC's Combat Experimentation Center at Fort Ord, California next spring.

You will note that we are placing considerable dependence on weight and cube saving flexible packaging to aid in implementing our new feeding concept. We are studying both rigid and flexible containers so we may arrive at an optimum packaging system.

Design studies are in progress on both expendable and non-expendable devices capable of heating from 1½ to ten gallons of water. These are primarily intended for use with precooked dehydrated foods. We are particularly interested in inexpensive rapid acting devices that will heat water from 40°F to 212°F. Among the approaches being evaluated are: gasoline, and solid fuels such as trioxane.

To round out the feeding story, I would like to give you a brief progress report on our irradiated food program.

Late in April 1958, soldier volunteers had their first taste of irradiated food prepared and served as part of a regular mess hall meal in a troop acceptance test conducted at Fort Lee, Virginia. Further feeding tests, designed to establish that food preserved by ionizing radiation is acceptable to troops on a basis of flavor and texture will be conducted, intermittently over the next 2 years, by the Quartermaster Corps, with the aid of representatives of the Surgeon General.

By mid-1960 we expect to have in operation at Sharpe General Depot in Stockton, California, the world's first pilot production facility for the irradiation of food—the U. S. Army Ionizing Radiation Center. The design capacity will be 3000 pounds per hour of food irradiated at a sterilizing dose. This facility, which will utilize Cobalt 60 as a gamma source and a linear accelerator electron source will demonstate the technological and commercial feasibility of radiation preservation of foods, stimulate the interest of the food processing industry and produce food items required for projected studies.

CLOTHING TOMORROW'S ARMY

We are presently attempting to combine into a single integrated clothing system protection against a variety of hazards:—CBR, thermal, ballistic and environmental. This is a tremendous job and like so much of research and development, progress is made in terms of "nibbles"—not an unbroken chain of spectacular advances. Ordnance, Chemical and Medical are contributing their know-how to our efforts.

Adequate thermal protection of the soldier is one of the unsolved problems of modern warfare. To fully exploit atomic firepower troops must not be unduly restricted by the thermal barrier imposed by an enemy's nuclear weapons. Beyond the critical range of blast and

nuclear radiation, the individuals' chances of survival increase rapidly providing he is not a burn casualty. Our laboratories are attacking the problem.

We are constructing at Natick, Massachusetts a specialized high efficiency solar furnace which will be the largest in the United States. Primarily it will be used to test, under laboratory conditions, materiel for protecting the soldier against thermal radiation.

In the headgear field two new items are nearing the end of their testing cycles. The first is a nylon tanker's helmet which is now being production tested (to insure mass producibility) prior to adoption by the Army. It is likely that Army aviators will wear a somewhat similar item. This helmet, produced from layers of nylon fabric bonded together with a synthetic resin, will provide a high order of bump and fragment protection as well as integral Signal Corps' communications equipment. The second item is a new nylon liner (to replace the standard phenolic canvas liner) which will be married with the present standard M-1 Steel Helmet.

In the footwear field, we expect to substantially reduce logistical support by the use of a direct molded sole vulcanized bottom construction for footwear. The process employed involves the direct vulcanizing of rubber bottoms to leather uppers. We expect that this method will eliminate the basic cause of footwear failure, i.e., separation of the outsole from the upper.

For the protection of the Nike and Corporal missile men—we have just adopted an improved modified rubber coated cotton fabric suit which is serviceable over a wide temperature range and gives a high degree of protection against liquid fuels. (The Chemical Corps, working on respiratory devices, collaborates closely with the QMC.) We are developing an auxiliary cooling device to provide relief to fuel handlers wearing these impermeable suits. If you have any ideas that may assist in solving this problem, we would certainly like to hear from you.

Recently, the Corps of Engineers and the U. S. Forest Service tested an experimental expendable firefiighters' ensemble developed primarily for use in the event of tactical atomic warfare. The ensemble can also be used for protection to bedridden personnel during hospital evacuation. This lightweight (1 lb. 10 oz.) inexpensive ensemble is worn over the duty uniform.

HOUSING TOMORROW'S ARMY

Our broad development program in tentage includes that required for missile-checkouts, maintenance for vehicles and aircraft, and, of course, personnel.

Future warfare concepts envision high mobility over a porous battlefield—conditions that indicate a requirement for lightweight, hastily erected shelters.

A portion of our program, therefore, is directed towards development of low cost tentage of limited service life. An experimental pressboard tent for providing cold weather environmental protection is being readied.

Prototypes of a lightweight tent for Command Post use, utilizing reinforced plastic frames (covered with 9 oz. sateen) appear promising. Very lightweight materials such as polyester coated fiber reinforced paper laminates and chemically treated lightweight fabrics are being explored.

The possibilities of producing foam plastic tents in the field by spraying are receiving study.

Air supported coated fabric tents primarily for missile checkouts (such as the Redstone), as well as an air inflatable vestibule for use with standard tentage are under development.

A 75′ diameter Geodesic Dome, with aluminum frame and a vinyl coated nylon skin, is being evaluated for use as a medium sized hanger tent.

SUPPLYING TOMORROW'S ARMY

Under our new warfare concepts aerial delivery will assume a prominence in future operations and it will be looked upon as a desirable, rather than an emergency, means of supplying ground troops.

A number of items have been adopted which today provides the Army with a capability of air-dropping loads of heavy equipment, vehicles and weapons weighing up to 21,000 pounds. Progress has been good but we are most anxious to improve the technique.

The current standard system of rigging loads for aerial delivery is costly, both in manpower and equipment. Items have to be well padded, securely lashed, carefully rigged and continually inspected to insure proper operation of delivery equipment. Loads that are normally mobile require, when rigged for aerial delivery, handling and moving with materials handling equipment.

An expendable paper honeycomb-plywood platform assembly which will permit mobile loads to be driven on the platforms (rather than lifted) is being extensively tested.

Another method of aerial delivery is dropping petroleum in 55-gallon drums and rations using paper honeycomb without the platform sandwich assembly. The use of paper honeycomb, as an energy dissipating material, allows the use of a 22 foot diameter parachute in place of the more expensive 64′ chute. This increases the rate of descent from 25 to 75 feet per second and thus increases drop accuracy.

Rigid plastic foams and foamed glass have been found to have energy-dissipating characteristics potentially suitable for use under air-drop loads. (Incidentally, aluminum honeycomb has properties which make it attractive for our use but the present cost picture is a deterrent). Work is underway to develop plastic foams capable of being foamed in the field. What we would like to do eventually is to develop a technique whereby the foam energy dissipator would be formed under the load during actual descent to the ground.

Expendable (one time use) cargo parachutes of low cost are also in our present development program. Consideration is being given to polyester film, and reinforced paper base materials as well as fabric composites. To give you an idea of the magnitude of this type of operation, during the period 1950-1953 some 53 million dollars worth of cargo parachutes were procured.

Various developmental approaches are underway to solve the difficult problem of improving parachute disconnects. What we are aiming for is a family of truly reliable disconnects to prevent the cargo damage which occurs when parachutes drag the load across the drop zone.

Free fall (no parachute) 5 gallon and 25 gallon disc-shaped fabric reinforced rubber containers are being developed for providing drinking water and fuels and lubricants to advanced or isolated groups.

We are investigating an ultra-fast opening parachute system for emergency use to save the crew members of the Army's experimental aerial jeep, should malfunction occur. Since these vehicles will operate at low altitudes, fractions of a second become important.

In our work on materials handling equipment we are developing a family of rough terrain fork lift trucks (up to 15,000 lb. capacity) which are capable of beach operation (including surf up to five feet of water). To help solve the huge task of moving gasoline rapidly, we are developing a family of collapsible containers to quickly convert trucks and aircraft to bulk petroleum carriers.

SIGNAL

BRIG. GENERAL A. F. CASSEVANT
Commandant, U.S. Signal Corps School
Fort Monmouth, N.J.

A *dawning era of space exploration,* new weapons and *delivery Means, nuclear explosives* and the *leaner, better-gunned* and *more mobile* Pentomic forces of your Army and their *mode of operation* have brought about pronounced changes in how all Army arms and services must cope with modern warfare. Rather than list what this means to the Signal Corps in terms of its current missions, I will highlight some of the things we are doing and working on.

First, for *command control*—the commander's management of his weapons and forces. Its exercise requires the efforts of his staff and a triadic system of *communications, combat surveillance* and *electronic warfare.*

For the first of these—*communications*—the Army Signal Corps provides a global communications system using long-range radio and wire facilities and also the tactical communications systems for Field Armies and supporting forces. The world-wide system links Department of the Army Headquarters with the Army echelons within the United States and the overseas headquarters. The system handles an average of *361,000* messages daily or something like *130 million* a year. To meet the greatly reduced *time dimensions* of modern battlefields, the first automatic data processing facilities were added to this existing global network early in 1952.

For the tactical communications systems for Field Armies and supporting forces, a new area communications system will permit commanders to control more subordinate units over longer distances. The grid concept of the system calls for alternate communication centers as well as many alternate communication channels. Such elements now commercially used as toll dialing—permitting a soldier to dial a long-distance number to another unit directly, and radio switching centrals to handle radio subscribers, will be extended to these tactical communications in the field. We are also testing the use of air transportable packages of communication equipment to give the combat flexibility needed. Radio relay stations mounted in shelters and carried by helicopters—called heli-huts—and air lifted radio stations are aimed at overcoming such obstacles as mountains, rivers and extended communication distances.

Tactical radio relay stations employing tropospheric scatter techniques are under test. With tropospheric scatter techniques, the transmission is beamed at an angle toward the tropospheric layer above us and the waves are reflected back to the ground much further away than was possible with direct line-of-sight transmission.

The technique gives us three to four times the former distance with a corresponding reduction in the number of radio relay stations and combat area density. Inflatable antenna dishes which are coated with radio-reflective coating have already been developed.

The ionization effects of a nuclear blast on radio and radar systems make wire communications a vital part of the tactical communications picture. We now have a coaxial cable for connecting rear areas which is less than half the diameter of a lead pencil. It is so light it could be laid by one aircraft across the Atlantic.

An automatic data processing system for the Field Army—the tactical counterpart of that being used and expanded over the world-wide communications network—is under development.

A new transistorized family of radio sets and lightweight wire equipment is being developed for the Pentomic division and battle group. Among these are a small pouch-type radio with a range of 1 mile and a new pack set which occupies only two-thirds of the space of the set currently used. Others are a field teletype printer that weighs less than a soldier's pack and a tiny tactical radio that can be carried on the soldier's person. Experiments with solar cells to adapt sunlight for powering these small radios have been successful. We believe they can be extended to other tactical equipment.

To help commanders communicate with and control their Army aircraft, a new aircraft radio is being developed to replace the present set. It will weigh about 25 pounds and have 800 channels, four times that of the current set. The high concentration of Army aircraft in a given airspace in combat makes a tactical air control system essential.

Enemy counter-measures and detection will make radio silence a prime tactical virtue. To this end, a self-contained inertial navigation system is being developed which involves a very limited radiation and is designed to remove any requirement for contact with ground-based navigational aids. Among its features is automatic flight control, allowing for programmed flight.

I want now to mention a few things we are doing in the second area of command control—*combat surveillance,* gathering information about the enemy and his areas. Commanders must have information on fleeting targets with sufficient speed and accuracy to permit destruction of these targets before they disappear or take action against our own forces. The range of missiles in our fire support covers hundreds of miles. To employ these and other weapons, rapid and effective

target acquisition capability and long- and short-range surveillance are vital.

One of the newest advances is the drone reconnaissance system. These pilotless aircraft are being designed to carry a variety of sensing devices. They do not need a take-off or landing strip and are controlled in flight and recoverable. A camera has been developed which will automatically photograph a strip exposure of terrain. It has its own automatic flare ejection device to allow it to take photos at night.

Of tactical radars under development for combat surveillance, one is the SILENT SENTRY, a portable set weighing only 80 pounds. A medium range tactical radar is being worked on for use at division level. Augmenting outposts and listening posts, these radars will provide surveillance of an area thousands of yards to the front and to the flanks, day and night, under all weather conditions. Two types of airborne radar for Army aircraft are being tested to give commanders vertical surveillance of surrounding areas.

Also under development is an airborne television system which can be carried in Army aircraft. The need for all-weather, day-and-night operation presents such problems as resolution of a photograph or television with poor or no illumination.

For ground use, a tactical, light-weight television called TELESCOUT has been developed. It can be carried by one soldier. The receiving station is mounted in a jeep.

To transmit combat photographs rapidly a polaroid facsimile set has been developed which can be carried in a jeep.

These are a few of the new surveillance systems and devices we are providing or working on.

In the third area of command control—*electronic warfare*, equipment is being developed for counter-measures and counter-counter-measures. We want to be able to prevent disruption of our own command control system while having the capability to disrupt the system of any potential enemy.

To tie these sub-systems together and to give commanders faster command control over dispersed battle elements, a tactical Army operations center is being developed. It is an electronic nerve center which will give the commander refined means of coordinating weapons, combat surveillance, electronic warfare and tactical Army aircraft elements. The center will be vehicle-mounted.

Let me turn now for a moment or so to the new and growing dimension of challenge—advanced missiles and space exploration.

The accelerated strides being made in missiles, rocketry and space technology—relatively new fields whose potential is even yet undefined—call for more and more emphasis on *radar, communication data transmission, instrumentation* and *aerially-borne power sources* which are peculiar to these new environmental needs.

A vital achievement in building for these new requirements has been the development of a target detection and coordination and control system for the Army's anti-aircraft missile system. This new electronics system—the MISSILE MASTER—works with NIKE-AJAX or NIKE-HERCULES missile batteries as well as with the HAWK, the low altitude air defense missile. The system collects information on location and identity of targets, presents it on electronic display consoles and distributes the data to the missile firing batteries. Information can be stored by memory equipment.

For the Army Explorer and the Navy Vanguard satellites, the huge Army Signal Corps Transmitter at Fort Monmouth on the coast north of here was used to help calibrate the Minitrack stations throughout the Western Hemisphere and on the West Coast of Africa. By bouncing signals off the moon, the stations were synchronized to the exact frequency of the radios in the satellites. These tests were also used to check the internal computing systems of the Minitrack stations.

We also adapted solar cells to convert sunlight into power for the smaller transmitter of five milliwatts carried inside the Vanguard satellite.

The Signal Corps is working to develop circuitry and assemblies to meet the demands of missile electronics. Guidance, instrumentation, sensing and control assemblies must meet greater and greater requirements of shock and gravity pressures. A major step that we have taken toward these advanced requirements is the development with industry of the production engineering of a micro-module production system.

These miniaturized modules will permit higher payloads, longer ranges and smaller sizes of missiles. Our objective is to develop the micro-module concept to the point where ground tactical, fixed plant and airborne systems could be reduced to one tenth or less of their present bulk and weight. Then a typical missile guidance and control unit could be reduced in weight by 90 per cent. An aircraft radio like that which I mentioned earlier could be reduced from 25 pounds to about four pounds.

I have outlined some Army Signal Corps efforts to help improve and advance the Army's deterrent strength and its combat capability. For these diverse fields of electronics and communications, the annual expenditure to operate and maintain the associated systems and equipment, is about 212 million dollars. Research and development runs approximately 71 million a year, while procurement and production presently averages 270 million.

But all these new systems, from pilotless drones with automatic sensing devices to the use of computers which can make 30,000 decisions in the time it takes to flick a light switch, are worthless without the indispensable commodity of warfare—the trained soldier. Whether it was in the ancient campaigns of Hannibal where he was skilled in the care, feeding and management of elephants in combat or the crisply paced warfare of missiles and nuclear bazookas, the soldier is still the only ultimate weapon.

To train him to put in, operate and maintain these systems I have talked about, the Signal Corps operates two schools—at Fort Monmouth, New Jersey and at Fort Gordon, Georgia. Last year we trained 29,000 students, almost a one-third increase over the preceding fiscal year. We expect this year's total to be about 31,000, including a majority of Signal Corps people for the Army in the field and also students from the other arms and services. A steady number of foreign students are trained under the Military Assistance Program.

While we admit to earnestly and aggressively seeking the best and most radically advanced communication and electronic systems for your Army, we are not beguiled into believing mystical black boxes will solve all our problems for us or replace the soldier on the battefield. No one yet has come up with a machine that will do the thinking, fighting and dying.

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ORDNANCE

Brig. General John G. Shinkle
Commanding General, Army Rocket and Guided Missile Agency
Redstone Arsenal, Alabama

MY purpose today is to tell you the place of the Ordnance Corps in our army of today and the part it plays in these dynamic times of the atomic bomb and of guided missiles.

The mission of the Ordnance Corps can be expressed in one sentence. The mission of the Ordnance Corps is "to provide the world's best weapons to the world's best soldiers."

The Ordnance Corps is what is known as a technical service as apart from the user services which are in the main the infantry, the artillery and the armor.

Weapons today range from the shoulder fired rifle and the hand held pistol all the way to the massive Jupiter missile. However, you cannot compare these weapons by comparing the size of the Jupiter missile alone with that of a rifle because the Jupiter missile is only a part of a weapon system, all parts of which are necessary properly to use the missile. This adds many times the weight and complexity to the weight of the missile alone. And so the rifle and the guided missile are the two ends of the spectrum and there is a whole gamut of weapons in between; this is a long and all-inclusive list. Every field of the physical sciences and all types of engineering must be employed in order to create them.

The Ordnance Corps is responsible for weapons from birth to death. In fact, the only exception to this all-inclusive duty is that of using the weapon in the field, which is the duty of the combat forces. Our responsibility starts with the research and development which evolves into the first working model, extends through the procurement of the weapons so that they may be issued to the combat forces, and even after the weapon is issued, we continue to insure that the proper repair parts are where they are needed and doing those more difficult repair jobs for which neither facilities nor people are available within the combat units.

In performing this job, we have a three-member team, science and industry together with the Ordnance Corps. Each of these team members has an important contribution. Science, in the person of educational institutions and the research portions of industrial concerns, must always strive after new knowledge. This is the process which is accelerating so rapidly in these times. Industry must take this new knowledge and develop the new weapons and, after development, manufacture them in the number needed by the Army. The Ordnance Corps must lead and guide this effort both by doing a small part of each process itself and by encouraging and directing the efforts of both science and industry to insure that the end result truly fills a real need of the Armed Forces.

You have already heard today that the Army needs a controlled force which it can place accurately upon a target. It is neither economically nor tactically feasible or desirable to blast the countryside to destroy a squad or a single strong point. Thus, there is a requirement for a series of weapons of graduated power, each of which must have pinpoint accuracy with respect to the power of its warhead. Accuracy is a major requirement in our weapons systems. The next requirement is for reliability. The present guided missiles put electronic circuitry, far more complex than a television set, into an environment worse than a two automobile head-on collision. And still the missile must remain in that environment for a period of minutes or hours and work at the end of that time. This matter of reliability is a very real thing. In combat a weapon *must* work. We must in all our missiles work as near to the 100% reliability as it is humanly possible to attain.

The third of our triumvirate of requirements is mobility. I do not think I have to elaborate upon the needs for mobility because that subject has already been adequately covered.

These three basic requirements for weapons today, accuracy, reliability and mobility, point quite clearly to the fields of knowledge in which we are working today and in which more knowledge is always urgently needed. In the area of atomic warfare, the Atomic Energy Commission is responsible for the development of the warhead itself. In that area rapid strides are being made in reducing the weight and size of the warheads and at the same time maintaining or increasing their potential. Accuracy is a resultant of many things, the guidance, the propulsion, and the fusing, among others. Electronics play heavily on these, but many other physical sciences are important as well. Infrared light and visible light technologies are heavily used. Chemistry with respect to propulsion principles is the essential ingredient and even the old mechanical principles must be employed in newer or in more precise ways.

Reliability and its requirements are forcing an entirely new approach in the electronics industry, for example. Electronic devices are no longer concerned only with communications like the radio and TV set. One of the most startling areas being developed is that of miniaturization and, as is so often the case, two birds are killed with one stone. This process, while adding to reliability, also cuts down the weight and cube of the

equipment in which it is used so that mobility and logistics are much improved. This is one attack on the mobility problem. Materials research and applications are doing a great deal also. Old materials such as steel are being improved in the yield strengths continually. New lightweight materials are being added to those we have used in the past.

In deference to this group today, I would like to go a little more deeply into one specific subject for supporting research and development which is contributing today heavily to all three of these development objectives. This is the area of solid propellants for guided missiles. Solid propellants for military rockets were almost completely abandoned immediately after World War II. Liquids gave much better impluse per weight of propellant and the complete power plant using liquids could be made lighter overall than a solid propellant motor. When you consider that one pound of payload for a long range rocket requires about 10 lbs. of propellant, you can see how important greater impulse and lighter motors are. For about ten years the Ordnance Corps has supported, in its own laboratories and by contract in civilian laboratories, an active research and development program in this area. The result has been that today almost all of the new Army guided missile systems use solid propellants. Their reliability, ruggedness, and simplicity of handling are a handsome payoff for these years of effort.

And what should we look forward to as problems to be solved in this specific field? First, solid propellants today can be made which closely approach the theoretical impulse which is obtainable from a chemical system containing carbon, hydrogen, oxygen and nitrogen. Basic work needs to be done to evolve military propellants in other chemical areas which have a higher potential as rocket fuels. A military item must be stored for a long time and then used in an ambient temperature of from —40°F to +125°F. We must work to improve storage life and the temperature range of use of those propellants now in use and to be developed. Solid rocket motors as well could be much more generally useful if there were some way to obtain an exact amount of total thrust.

I think now is the time when I should report to you about some of the concrete results which have been obtained in the form of actual weapons systems and improvements.

The 175mm gun is the latest, as well as one of the most versatile of artillery pieces. On the battlefield it is superior in many respects to the combined capabilities of the 155mm gun, the 8-inch howitzer and the 8-inch gun. The 175mm outstrips all World War II weapons in its ability to fire readily in any direction and to move into firing position quickly.

Our new M14 rifle replaces three former shoulder weapons.

The M60 general purpose machine gun replaces all three of the former caliber .30 infantry machine guns. The M60 equals or surpasses the other three in rate of fire and weighs only 23 pounds.

Other new developments include:

The M274 mechanical mule, for example, which carries 120% of its own weight.

The M40 160mm battalion antitank recoilless rifle called The Bat which provides great armor destroying ability.

And the M59 personnel carrier, a fast amphibious cross-country vehicle that can carry an entire squad in armored protection.

Looking now at the field of Army rockets and guided missiles, the American soldier will be armed in the near future with a massive array enabling him to meet every tactical requirement regardless of weather or visibility.

Probably the best and most comforting indication of things to come in the area of rockets, missiles and atoms is a quick look at the accelerated progress achieved over the past five years:

As short a time as five years ago, there were no operational Army missiles. Today's three—Nike-Ajax, Honest John and Corporal—will be suplemented soon by a host of others. This group includes small and large free-flight rockets, anti-tank weapons, two generations of surface-to-surface missiles, two generations of anti-aircraft missiles and anti-missile missiles.

Only a few years ago the first atomic firepower—the 280mm atomic cannon—became available to the Army. Two other weapons—Corporal and Honest John—now greatly broaden our operational atomic capabilities. Soon most army missiles will have an atomic capability.

Also in atomic firepower, Ordnance scientists and engineers continue their development work on adapting various AEC-developed nuclear warheads to new missiles and rockets.

A quick summing up shows that we have many U. S. Army rockets and guided missiles now either in development or in the field.

In the surface-to-air category we have three. The Nike-Ajax: In test after test the supersonic Nike-Ajax has knocked down every type of target offered.

Nike-Hercules is a second generation weapon capable of carrying an atomic warhead, and flies higher, faster and farther than Nike-Ajax.

The Hawk missile is a "bullet with a brain." It will be used for defense against low-flying aircraft and has a lethal, modern warhead. Its guidance techniques have proven extremely successful.

The surface-to-surface category of missiles stretches all the way from the little Dart missile to the mighty Jupiter. The Dart is a highly mobile guided antitank missile and offers a high probability of first-round hit with a warhead which can defeat any known armor.

Our new supersonic free-flight rocket is called the Little John. It is powered by solid propellant, has a range of medium artillery and can be transported by helicopter.

The LaCrosse is a supersonic close-support guided missile of pinpoint accuracy. It is highly mobile and is now in production.

Honest John. This supersonic free-flight rocket can carry an atomic or high explosive warhead to a range equivalent to long-range artillery. It is operational in this country and overseas.

The Corporal is likewise operational today. This supersonic guided missile can carry an atomic or high explosive warhead about 75 miles.

(Continued on page 48)

Mr. James Sheridan, Allied Chemical, New York Chapter President, presides at afternoon session June 6

MEDICAL

MAJOR GENERAL SILAS B. HAYS
The Surgeon General

IT is a pleasure and real opportunity to discuss briefly the role of the Army Medical Service in support of the United States Army in modern warfare. Largely through the efforts of those you represent, not only the military but also the civilian population, lives in a rapidly changing environment. In the face of dynamic technological activities to which you contribute so much, we must have agressive evolution in Army medicine. Man is critically sensitive to his environment. To be effective, man must adapt to his environment to the degree of not only living, but of performing useful work to further various missions.

I do not want to give you the impression that this is our only role. Of course you are all aware of two of our three major efforts in Army medicine, namely: One—the *selection*, proper placement, and elimination of personnel; and two—*curative medicine*, or the care of the sick and wounded.

The third major effort, which actually should be listed second, is the *maintenance of health*. This is less well known to the public but is of tremendous importance. It will be the major topic of the next speaker.

To bring you up-to-date on selection, placement, and elimination of personnel, let me say that we are making great strides. Our examination procedures improve constantly with advances in science. For example, industrial know how which has been applied to medical laboratory procedures has mechanized and streamlined them. This enables us to use them as widespread screening tests for the many, rather than as diagnostic aids in selected cases for the few. We are doing, as well as keeping abreast of, research aimed at improving the evaluation of physical and mental abilities on the one hand, and at determining specific demands of each job for those abilities on the other. We are moving from evaluation of *disability* to evaluation of *ability, a really tremendous step in social evolution.*

Likewise, we are experiencing significant gains in curative medicine. This speeds up the return of the sick and injured to duty. In turn, this lowers replacement requirements. This represents the salvage of the scarcest military commodity, the trained soldier. The lead time for the production of a soldier averages 19 years, the longest of any weapon of war. The soldier is highly perishable and, above all, is endowed by the Creator with that most precious gift, life.

Last year 103 Army physicians and surgeons successfully passed examinations of the American Specialty Boards, thereby becoming marked as national leaders in their respective fields of saving life. This came close to equalling in one year the 1947 cumulative total of 140 diplomates Army-wide.

We commenced this year with nearly 600 certified specialists with a range of 34 specialties. This represented 34 percent of our Regular Army doctors. In addition, another 33 percent are Board eligible. Thus, two thirds of our professional military physicians are highly specialized in the life saving arts and sciences.

At present one of our crucial worries is the management of anticipated tremendous numbers of military casualties in modern war. To this must be added conjectures upon what we may be called upon to provide in assisting the civilian population in disaster. But I must pass on from these problems, about which we could talk for days. Suffice it to say that we are conducting research and training designed to improve our mass casualty capability.

Let us move on to the field of health maintenance. I have long been a proponent of conserving our fighting strength, which is the Army medical mission, through maintaining the health of the individual soldier. This basically gets down to study and subsequent control, or minimization of the adverse effects, of the environment upon the individual. This is *preventive medicine*. Army contributions to preventive medicine have been legion. To name a few: Sternberg was a great pioneer in bacteriology. Walter Reed, Sternberg, Kean, and Gorgas controlled yellow fever and malaria. Ashford, in Puerto Rico, demonstrated the principles upon which hookworm later was brought under control in the United States. Russell and Darnall brought the scourge of typhoid fever under control, and in so doing brought safe chlorinated drinking water into the homes of America. Dunham wrote one of the early comprehensive texts of preventive medicine. In passing, Harry Lorenzo Gilchrist, the third chief of the Chemical Corps; Albert James Myer, founder and first chief of the Signal Corps and the progenitor of the United States Weather Bureau; and the incomparable Leonard Wood were Army doctors just slightly afield. All of these great military physicians worked towards the understanding and control of the living environment. We still practice their teachings and techniques. Now you, and the physical and biological scientists, are confronting us with increasing complexity and hazard in the work environment on the one hand, while on the other you present us with improved means of control. This puts us in the difficult role of not only keeping abreast, but of anticipating you. Then we must use the means you put into our hands, or which we develop, to enable our people to live and work safely with the materiel and munitions you supply.

This is no mean task. It entails extensive postgraduate training for our physicians and allied medical scientists. It requires establishing mutual two way channels of communication for the benefit of all. It requires that we get to know each other, and our respective tasks, on a first name calling basis.

MEDICAL

COLONEL JOHN R. HALL, JR.
Chief, Occupational Health Branch
Preventive Medicine Division
Office of the Surgeon General

LET us examine modern industrial or occupational medicine and see how we apply its principles in the modern Army. First, we find *selection*, proper placement, and elimination of personnel on medical bases. This we have done in the Army for generations. Further, to maintain health one must examine the individual periodically, detect disease or precursors of disease, and institute corrective regimens. This we have also done for generations. But we have materially improved the scope, adequacy, and yield of these periodic examinations and extended their frequency to greater numbers.

Persons known to be at increased risk because of adverse living or work environments are examined frequently. Thus, the examination programs of industry, as you know them, parallel those of the Army.

General Hays also touched upon curative medicine, which we find well established—in fact it was the foundation—in occupational medicine. We shall always have the sick and injured. As new materials and munitions are introduced, we must anticipate or learn through research and experience how they affect men who work with or near them. This not only gives us the basis for intelligent treatment of the inevitable casualty; it also gives us the basis for prevention of environmental exposures which may result in noneffective personnel.

In this effort we have a vast area in which you and our medical people can work to great mutual advantage. For this reason you should understand the principles upon which we work. First, we must know the location and nature of each potential hazard. If even minute overexposure to hazard potentially exists, then exposure must be prevented or controlled. Second, we always have the primary objective of engineering out the exposure wherever possible. In case this primary approach is impossible, then as a secondary effort we must select protective routines, devices, and equipment, to control exposures.

Let me digress to say that the Army collected the specimens and isolated the virus of Asian influenza while it was still in Asia. Hilleman, a great civilian virologist working for the Army at Walter Reed Army Institute of Research, grew the virus and proved a vaccine could be made. We then placed this in the hands of the National Institutes of Health. In turn it was distributed to industry, which did a magnificent job. vaccine production. Those of you who were protected

Now, let's see how these principles and methods affect you and how you can help us. First, we critically review military specifications for materiel you will provide, or we carefully study, and sometimes do medical testing, of items you propose for military use. In these studies we look for components or procedures involving substances known or suspected of being toxic or hazardous. We ask you for frank data concerning your proposed or adopted product. This often includes searching inquiry into matters you may regard as manufacturer's secrets. We assure you we will hold the data you give us under these circumstances in confidence. We mean it. We need your confidence in providing factual data concerning component or incidental materials of fabrication. We need any specific biological effects data you may have with respect to these materials.

Our end objective is to assure that through our combined efforts we place into the hands of our soldiers materiel and munitions from which hazards have been excluded, or that we provide before the fact protective devices and techniques for those which must be hazardous.

Much of our health maintenance work is centered in the Environmental Health Laboratory. It has a staff of over one hundred. They range from highly specialized physicians through the various engineering disciplines, wet and dry chemists, physicists, entomologists, toxicologists, industrial hygienists, optometrists, radiation engineers, radiobiologists, and others. But in the final application of the knowledge developed, we depend upon the skilled physicians and their medical teams at military units and installations to carry the medical load on the spot.

Now to get back to interrelations. We can, in turn, help you. In the process I have described, we develop considerable data useful in new developments and techniques. Within the realm of maintaining confidences that I told you we guarantee, we can provide you with beneficial information.

We, along with our sister services and the Atomic Energy Commission, assist in maintaining a Toxicological Information Center as an agency of the National Research Council. Services of this clearing house are available to you.

In addition, we attempt to keep abreast of occupational medicine in the civilian economy, we know many of your medical and safety people and want to know more. We encourage the exchange of information.

I have been trying to tell you of our mechanisms in peace and in war for achieving the maximum results in the maintenance of the health of the men and women of the Army. They are equally applicable in peace or war.

If we all work to perfect and maintain these mechanisms now, then the advent of war with its terrors and primitive existence, if—God forbid—it is thrust upon us, will find us better prepared.

TRANSPORTATION

Brig. General Robert C. Tripp
Assistant Chief of Transportation

IT is interesting to note that mobility has traditionally lagged behind the other elements of warfare. The weapons of the Napoleonic era bore little resemblance to those of Alexander's time. But despite this great discrepancy in weapons, there was no such difference in the mobility of the two eras. Napoleon depended upon a horse's hoof and a human foot for movement to and on the battlefield just as Alexander did. In other words, whereas the evolution in arms has been spread over centuries, advances in mobility have been limited to the last fifty years or so. If mobility is not to lag still farther behind our weapons systems, we must make great strides in this important field in the near future.

As you undoubtedly know, new concepts of how we shall fight the wars of the future put great stress on the use of aircraft—some go so far as to envisage a 100% air LOC. However, although we in TC are fully in accord with using the air to maximum extent feasible, we do not feel the Army of the future can eliminate entirely its dependence on surface transport in various forms.

Of course that does not mean that we are satisfied with them as they exist today. We definitely are not. We want equipment which will permit greater mobility, require less maintenance, and will simplify the over-all transportation problem.

To illustrate the problem let us assume that a war has begun somewhere on the Eurasian land mass. First of all, you must recognize that, in order to achieve mobility and dispersion, we shall cut down the accumulation of large stock piles of supplies in the theater of operations. Under such conditions the logistic system must be extremely sensitive to the immediate needs of the commander, and the overall transportation set-up must be completely integrated so as to respond quickly and flexibly to every requirement.

Should the equipment be airlifted from CONUS overseas, the Army will have a very definite interest in the type, size, and capabilities of the aircraft used, no matter by whom it is operated. This craft should be capable of accommodating equipment up to the size and weight of the 30-ton light tank.

In this connection, it should be pointed out that the overseas theater might be located in an area such that water-based aircraft would be a definite advantage. We are very interested in the possibilities of this type.

If the shipment is to go by surface transport, it is quite likely that it will be outloaded from many small ports and beaches rather than from major ports whose use would be limited by actual attack or threat thereof. Likewise the type of shipping which we would like to find at these ports would be somewhat different from today's, in that the roll-on roll-off method of cargo handling would be used extensively, so that cargo such as tanks, trucks and other self-propelled vehicles will be able to roll-on and off under their own power. This type of equipment accounts for approximately 26% of military tonnage.

A roll-on roll-off vessel with a cargo tonnage capability 25% larger than a Liberty ship will be capable of loading or discharging within ten hours. The first prototype vessel, "COMET," was launched last year.

Another improvement in cargo handling which will gain in importance is unitization of cargo, the technique of packaging supplies into units for shipment. A great quantity, in fact 42%, of our military cargo comes in small packages. During World War II it finally occurred to us that a portion of these could be strapped into pallets and since the war we have carried this a step farther by the development of containers.

When our shipment reaches the far shore, we can expect 50% and perhaps more will be unloaded offshore and transported across beaches or even less favorable shore terrain. Furthermore, the discharge operation will be dispersed up and down the coast with no more than two ships unloading at a single point and discharge points separated by several miles. Never again can we expect to have the large concentrations of ships, landing craft, men, and material which we had in World War II.

The unloading will be carried out by our Transportation Terminal Commands which will be so organized as to supervise operations at widely separated points.

Our basic terminal equipment can be broken down into three families, each with three sizes of equipment. First, a family of landing craft; second, of amphibians; and third, of rough terrain transfer equipment.

In the family of landing craft we have the LCM 6 with a capacity of 30 tons, the LCM 8 with a capacity of 60 short tons, and finally the LCU with a capacity of 150 short tons.

Improvements in this family of craft will be in the direction of increased speeds, maneuverability, and ability to operate in less favorable weather and water conditions.

The next family, amphibians, will have a 5-ton vehicle, a 15-ton vehicle, and the BARC with a capacity of 60 tons. This last vehicle was designed to provide a means of transporting Army vehicles and heavy cargo up to 60 tons (100 tons in slack water) from ship to shore over the beach and to points inland. With the

exception of the BARC we are not satisfied with existing amphibian equipment. The World War II types were basically road vehicles. We are now developing replacements to those vehicles which will put emphasis on marine capabilities.

The third family is that of rough terrain transfer equipment. We will have rough terrain forklifts of 6,000 lb. and 10,000 lb. capacity and a rough terrain crane capable of handling loads up to 30,000 lbs.

In addition to the more or less standard equipment just described there are a number of specialized developments which are designed to increase our flexibility in choice of unloading location. The first of these is the landing craft retriever which was designed for use in recovering beached or damaged landing craft around the beach. Its mission is to recover, in up to six feet of water, landing craft up to the size of our LCM 8. An important outgrowth of its capability is that it can safely beach such craft on dry land whenever severe weather would otherwise require their removal to a safe harbor. The flexibility which this permits in choice and continued use of exposed beach areas is obvious.

The next item is the aerial tramway. The outstanding feature of an aerial tramway is that it will permit movement of supplies across shore lines which would otherwise be unusable.

Still another item which will materially speed up the movement of cargo from ship to shore is the beach lighter. A new 338-foot beach discharge lighter has recently been launched. The basic purpose of this vessel is to permit the discharge of roll-on roll-off shipping where regular terminal facilities do not exist.

In considering this problem of getting our cargo from ship-to-shore and on into the interior we can never lose sight of the ever present threat of enemy attack by missile or aircraft. Our objective therefore must be to effect the unloading as rapidly as possible with a minimum of men and equipment. It is obvious then that we must point towards handling cargo in unitized packages and preferably on equipment which can roll off on its own wheels.

The objectives which I have just mentioned bring us now to a method of transferring cargo from ship to shore which I feel should receive great emphasis in the future. It might be called "Sky-hook" logistics. At present we do not have helicopters with sufficient lifting capacity to make large scale movement of supplies from ship to shore a possibility. Studies are underway, however, for construction of such craft.

In my opinion a heavy lift helicopter is one of our most urgent requirements.

Once the supplies have crossed the ocean and been moved ashore to some transfer point they will be loaded on to transport for movement forward to the combat zone. A portion of the supplies will of course move forward on the same vehicle in which it was unloaded from the roll-on roll-off ship. For the remainder, however, we must make a decision as to the type of transport which will be used for onward movement. For the highest priority supplies, shipment will be made by air.

As I pointed out earlier, we feel that we must be prepared to utilize any form of transportation which is available and suitable in the theater of operations. Experience in Korea showed that the capacity of rail network is not as easily destroyed as expected, and of course the economies of movement by rail are tremendous. For example, one of our studies shows that to support ten divisions of troops by a 100% ALOC of 500 miles would cost over six million dollars per day. On the other hand a system closely resembling the World War II Transportation net-work in Europe consisting of 1% air, 9% motor and 90% rail for the same distance would cost only *$177,000* per day, less than one-thirtieth of the cost of an air LOC. The most practical and efficient combination will of course lie somewhere in between these two extremes, and we are conducting studies to determine just what combination we should strive for.

In the field of motor transport we can expect much more drastic changes than in the rail field. Important as motor transport was in World War II, I feel it will be even more vital in a war of the future. As a matter of interest, we have almost one vehicle for every two men in our Army today.

The greatest emphasis will be on off-road mobility. New tactical concepts call for widely dispersed units operating in islands of resistance. It does not envisage complete control of the intervening real estate. To meet this we envisage each supply convoy as an armed task force, capable of the utmost in off-road mobility and carrying the maximum amount of pay load with a minimum of equipment and personnel.

I should like to describe at some length our concept of a logistical land train which we feel represents something of a break-through in the field of mass tonnage movement, not only in its present stage of development as a diesel powered unit, but more particularly as a potential nuclear powered vehicle. It is one of the best answers to meeting the requirement for a combination of maximum mobility with high cargo carrying capacity. Although this particular vehicle was developed specifiically for use in the Arctic (and has been successfully tested in Greenland), there appears to be no major obstacle to further development [for] cross-country operation under many different types of terrain and climatic conditions. This present design consists of a lead vehicle containing the diesel power unit and powered cargo trailers.

We believe it is feasible to develop an engine utilizing nuclear power for this land train. During WW II it was frequently commented that more men were driving trucks than shooting rifles: An off-road train, whether conventionally powered or driven by a nuclear reactor, will go a long way towards reducing this requirement for vehicle drivers. A study was made comparing the men needed to move 8,000 tons of cargo a distance of 100 miles daily. The comparison showed the off-road train would do the job with less than one-fourth the number required for trucks.

Some of you may have heard of the GOER type vehicle which is based upon some of the principles embodied in our earth moving equipment. I visualize that there will be a need for a family of these vehicles which will utilize the principles of large wheels and big tires together with wagon-type steering.

For the hauling of bulk liquids we are working toward utilization of collapsible tanks of various sizes. Another possibility which appears to have considerable promise is the use of rolling fluid transporters. Tests in Greenland have indicated that a prime mover can haul several times as much fuel, using rolling fluid transporters, as would be possible if the fluid were placed in tanks on sleds.

Let us next take a look at requirements in the theater of operations for movement of personnel and supplies by air. The Army, as you know, is at present limited not only to prescribed weights and types of aircraft, both fixed and rotary wing, but also to operation of such craft in the combat zone. This means that we must integrate the operation of Army aircraft with the Air Force system in such a way as to make the most of a very restricted capability.

The Army in cooperation with the Navy and the Air Force is sponsoring numerous projects in aircraft.

ENGINEERS

BRIG. GENERAL J. L. PERSON
Assistant Chief of Engineers for Civil Works
Office of the Chief of Engineers

SINCE 1945, we as a nation have been striving to determine the implications of nuclear weapons on modern warfare. Much theorizing has been accomplished, many proposals advanced; many prophets have risen to the foreground. During the past five years, changes have taken place which will allow the Army to accomplish its assigned missions in this initial phase of the Atomic Era. Two significant changes have occurred: (1) we have begun to equip with tactical nuclear weapons and (2) we are revising our tactics and reorganizing our units to fight a nuclear war. Nevertheless, we are prepared to fight without these powerful weapons.

There are many variables associated with modern warfare: the use of atomic weapons; considerations of limited or total war; economic versus purely military considerations. Mobility and dispersion have assumed increasing importance. Let us briefly see how these desired characteristics influence military engineering and the American Chemical Industry.

The first desired characteristic is a high degree of mobility within the battlefield.

There is not at present, nor will there be in the immediate future, any vehicle which has 100 percent all-weather, cross-country mobility. Some day perhaps there will be, but until such a vehicle is in service in great numbers, we must continue to rely on roads, bridges and ferries to keep our combat vehicles and support equipment moving. By this I mean we must continue to move in contact with the terrain, and a foreknowledge of this terrain, in its infinite variations, is essential to mobility.

We must further improve our means to rapidly produce a color map of an area. We must reproduce this map in several scales and in quantity to permit immediate distribution to troops. And this map making means must itself be mobile.

The growing requirements for cross-country mobility greatly increases our need for knowing and depicting varying conditions of trafficability. Moreover, the great and increasing ranges of missiles have sharply accentuated the need for a high order of geodetic data in order that effective counterfire may be delivered. Thus both the scope of the intelligence we need and the information which maps must provide exceed what has been necessary in the past. With your help we are solving our problems in this important activity area.

There continues to be a bridging requirement for all military operations. Near the front edge of the battlefield, bridging equipment must be as mobile as the fighting units which are supported, and the time for emplacement must be decreased. Bridge structures are lighter and stronger as a result of research in metallurgy. For example, all-welded aluminum truss panels, believed to be the first of their kind in this country, are now under test by the Corps of Engineers. If successful, they will greatly simplify bridge construction. There is hope that studies of plastics may result in a radically new approach to the bridging problem. We envision that a material similar to styrofoam, which expands about 30 times its original volume on contact with air, may be sprayed into a gap to form a negotiable bridge in a relatively short time.

Most of you are aware, I am sure, of the continuing research by and for the Services for a truly rapid soil solidifier. Tremendous importance is attached to discovery of a solution to this problem.

Modern concepts of mobility demand that many types of operations be conducted at night. To improve our capability to meet this requirement we look to the infrared research program. Individual night vision aids have been used successfully to construct bridges and assemble missiles in the dark. Infrared target location devices assist in identification and location of personnel and equipment by measuring the heat given off by these potential targets. Items used in the past have been primarily of the active type in that they require a source of infrared to illuminate the objects viewed. The present emphasis is on passive type equipment which can make use of either the low levels of natural illumination such as starlight, or the heat radiated by potential targets for detection and identification.

There is a host of other items which in themselves do not constitute mobility but without which true mobility can scarcely be achieved. Within this category is a necessity for our supply and maintenance systems to be more responsive to combat needs. One objective in this area is to provide a family of construction type equipment specifically designed to perform combat engineer tasks while greatly reducing the numbers of different types, makes and models within the military supply system. Such equipment will be air transportable or air droppable. This equipment can be no better than the material from which it is made. We must have lighter, stronger, cheaper alloys, and treatments which will better protect from the effects of atomic explosions.

Another objective in this area is to insure that our means to provide drinking water, and to fight fires remain mobile. Chemical research has allowed us to keep pace in this area. However, the firefighters have a con-

tinuing, serious problem. The unconventional fuels that are missile propellants are subject to accidental fires which burn with such intensity and under such conditions that new methods and materials are constantly in demand.

While we seek means to improve the mobility of our forces, we seek also to restrict and retard movement of the enemy. Every advance in the chemistry of explosives is a contribution to the art of land mine and demolition warfare.

With our tactical units spread thinly, the number of land mines required to form an effective unit defense is enormous. Two problems are evident: (1) the problem of moving this great quantity of high explosives to and within the battlefield, and (2) the problem of physically uncrating, assembling mine and fuse, burying and arming the individual mines. What we need is a lighter, more powerful, more plastic explosive. While it is evident that certain basic chemical research is required, it is also evident that innovations within the area of predictable reactions must continue to be exploited.

Future ground operations will continue to be characterized by rapid concentrations, attack, consolidation, and dispersion. The second desired characteristic of a modern Army is the ability to operate efficiently while dispersed. The value we seek is the advantage in protection without loss of control. An over-all low density of troops will be created by widely spacing the combat elements without materially increasing their normal internal dispersion. This means we must be prepared to construct more roads, additional pipelines for transportation of POL supplies, and additional aircraft landing facilities in the battle area. Greater dispersion of storage and maintenance facilities will greatly increase construction requirements in the rear areas. Underground construction will also be required. Considering the higher levels of atomic weapons used, the degree of dispersion and protection required makes extreme demands.

The subject of protection is one which must be considered with dispersion. Armored personnel carriers and armored vehicles, as methods of providing continuous protection, are inadequate. These vehicles are tossed around considerable distances from ground zero as shown by the atomic tests; further, there are too few armored vehicles for combat elements to place complete reliance upon them on the battlefield. Modern weapons present a requirement for better fortifications and simultanously decrease the time available for units to construct these fortifications. The fluid battlefield concept must accommodate the reality that men and machines must pause to refuel and rest. In these periods, however brief, men and equipment must be protected by digging in.

In recognition of this problem we must improve the individual's capacity to construct field defenses. Highly resistant construction materials that are light weight and easy to work or assemble are needed. The ability to dig in will be enhanced by new high speed excavating devices and small explosive devices which can blow an individual foxhole. New types of controlled explosives are required. Basic studies of blast waves propagated at milli-second intervals appear to offer some promise.

The increased effectiveness of all weapons that may be employed against us has increased the importance of concealment and deception. The time required by the enemy to identify and bring fire on a target will be short and therefore limits the degree of acceptable physical defense that units can be expected to achieve. Camouflage and deception will serve as measures to thwart enemy efforts to identify our units, installations and intentions. The development of better camouflage materials offers a real challenge. Research in the paint and plastics fields shows some promise. Sprayed web-like coatings with sufficient strength would replace large, cumbersome nets. Paints or dyes that take on the optical characteristics of the surrounding terrain would, when used on equipment, facilitate concealment.

To summarize, we must continue to study, research and develop our engineer techniques, organizations, doctrine, training and equipment. The Chemical Industry can aid in finding needed breakthroughs in many of the areas of concern. Some of the areas of greatest concern:

1. A means of going directly from *nuclear power to electrical energy* without an engine generator as we know it;
2. *Improvements in fuels and engines* in order that fuel consumption and equipment weights may be materially reduced;
3. Improved methods of *rapidly moving large quantities of earth* with the least amount of equipment and minimum fuel expenditure;
4. Improved mines and demolitions and a means of *determining the location of mined areas from the air,* and of *detecting explosives.*
5. New methods of crossing barriers, both natural and man made.
6. More effective means of utilizing natural low levels of illumination, by image intensification, and of utilizing natural heat radiation of objects for detection and viewing.
7. Finally, and eminently important with the growth of missile systems, *a more rapid means of establishing geodetic control,* for mapping thousands of miles within the enemy's territory.

GEN. WALMSLEY IS FIRST MEMBER OF NEW CHESAPEAKE CHAPTER

Brigadier General Harold Walmsley (seated), Army Chemical Center commander, is the first member to join the newly organized Chesapeake Chapter of the Armed Forces Chemical Association. The Chesapeake Chapter is the name given to the merged Army Chemical Center and Baltimore Chapters of the A.F.C.A. David Bourque, resident of 1591 Kingway Road, Baltimore, and also a member of the local chapter, is an interested bystander.

U.S. Army Photo

THE BANQUET SPEECH

(Continued from page 14)

they would not hesitate to use chemical and biological weapons against us in war if this would best serve their ends, and the great extent to which they have so equipped and trained their troops leaves no doubt as to their intent.

I might tell you that Army Research and Development is devoting an increased amount this year to chemical and biological programs which we think is a fairly good cut of the Army R&D budget. It should be noted that any new Army weapons, in this category, can be most useful and available also to the Navy, Marines and Air Force, which do not have a Chemical Corps.

You may also have noted the Soviet intention to devote 100 billion rubles to develop their chemical industry, which means further military expansion since so little of their effort is expended for the betterment of their people.

I want to mention briefly the very important subject of propellants for rockets and missiles and how you can help the Army in this critical area. This is particularly timely since a second generation of missiles is now being considered for development. Really good propellants are vital to the Army since they provide the principal means for delivery of the business end of our weapons. We must have propellants in our weapons which are ready to fire on instant notice. One of our pressing needs for rocket and guided missile propellants is to get a lot more thrust in a small package. In short, we want pre-packaged propellants, either liquid or solid, with the highest possible specific impulses. We are, therefore, particularly interested in new chemical formulations, and new development in materials which have characteristics compatible with the high temperatures that may be expected from such high performance propellants. We are dependent upon the chemical industry to continue to push these performance characteristics toward the theoretical limit. More must be done in this regard. These high performance chemical formulations are necessary for the nation and for the Armies of tomorrow if we are to deliver the overwhelming firepower required to compete in any future war. The Army invites your assistance in providing these high performance propellants. The expansion of effort in propellant research will soon offer greater opportunities for you to assist in our defense effort.

I have offered you many facts this evening and some opinion. I hope the over-all implication has been encouraging as we are striving to increase national attention to the dangers from beyond, and to Army developments and requirements designed to deter or overcome renewed aggression. I would be less than honest and fair, however, if I left this audience with the thought that the road ahead is a clear path; that victory, if war comes, is certain. We must continue to earn the right to survive and remain free. This is not an inherent American right. Survival of the fittest is still a basic law in the plant and animal kingdoms. Only by positive and courageous action can we assure survival and further progress for ourselves and our children.

Liberty is a precious thing. It was bought with the blood of our fathers, and preserved by you and me and many of our sons within our lifetime. The Signers who pledged their lives, their fortunes and their sacred honor on July the Fourth, 1776, and the hundreds of thousands who gave their lives for America before, during and since the battle of Normandy, 14 years ago today, would look down on us with shame if they thought we would fail them now.

The potential enemy's capabilities are unbelievably great and are growing greater in both the military and economic fields. The hour grows too late to tolerate that seed of death called complacency, or those Fabian Socialists and Caspar Milquetoasts who through intent or ignorance would risk our birthright on the thesis that we should do nothing now, tomorrow will be better.

Among our problems I should also refer to the scientific and technological strides in education and in space being made by the Soviet Union compared with those taking place in this country. I cannot tell you how gravely I view these continued deficiencies. If we do not keep the torch of scientific progress and knowledge at its brightest point, we will be inundated by the Red tide of Communism and buried in the toxic darkness of a Communist-dominated world.

Please give this problem your patriotic support and interest. Give your country and your Army your continuing understanding and support. See that we use well those defense dollars allocated to your industries. They come out of your pocket and mine. We cannot buy bargain-basement defense. It won't stand up under the wear and tear of tomorrow's challenge.

That vital challenge of tomorrow is our greatest opportunity today—the opportunity to so advance, so build, so defend, and so cherish this land of ours that when the dim lights of this decade go bright again, America will still be enshrined as the leader of free men in the hearts and hopes of people all over the world. We can only remain "the land of the free" if we demonstrate with faith, sacrifice and courage that we are "the home of the brave."

CHEMICAL

(Continued from page 29)

vidual soldier's need for a radiological detecting instrument.

We are not limited in the radiological field to what has already been mentioned. The Chemical Corps has other responsibilities such as waste disposal, prediction of fallout patterns and the development of techniques for speeding decontamination against radioactive hazards.

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1958 WINNERS OF A.F.C.A.'s MEDAL FOR OUTSTANDING R.O.T.C. CADETS

The A.F.C.A. medal awards to outstanding ROTC cadets majoring in chemistry or allied sciences at twenty-seven colleges and universities throughout the country enrolled in the program were presented shortly before graduation this year. The group consists of eighteen Army ROTC members, four Navy and five Air Force. Increasing interest of the membership in this annual event was reflected by the participation in the award ceremonies of numerous chapters this year by their sending of chapter members to institutions in their chapter areas to make the presentations. The award is given to juniors or seniors. It consists of a bronze medal with blue and gold ribbon and an engraved scroll. Following are brief biographical sketches of the 1958 winners.

Mr. King George Irving, president of the Dallas Chapter, presents the Medal Award to ROTC Cadet Herbert Whalen (second from left), during award ceremonies at Texas A&M College, College Station, Texas.

BENJAMIN HAYES AVERETT

BENJAMIN HAYES AVERETT, JR., in this year's senior class at Wake Forest College, Winston-Salem, North Carolina, attained the rank of captain in the Wake Forest College ROTC Unit. Outstanding both in chemistry and military studies and activities, he was leader of the Wake Forest ROTC Drill Team. He served as commanding officer of the Pershing Rifles at the College; was a member of Scabbard and Blade and Kappa Sigma social fraternity.

Mr. Averett was born May 13, 1936 at Oxford, North Carolina, where he presently resides at 425 Linden Avenue.

JOSEPH MICHAEL FRIEDMAN

JOSEPH MICHAEL FRIEDMAN, Senior ROTC cadet at Rensselaer Polytechnic Institute this year was selected for the A.F.C.A. award from the outstanding ROTC students of the three services represented.

Majoring in chemical engineering, Mr. Friedman has received a number of honors. He was designated Outstanding Freshman in the Electrical Engineering Department in his first year, and in his Junior year received the Society of American Military Engineers Gold Medal Award as one of the ten outstanding engineering students in the ROTC. As cadet lieutenant colonel, he held the highest attainable rank in the Corps. Although he met approximately one-third of his college expenses by summer and part-time employment, Mr. Friedman engaged extensively in athletics and extracurricular activities. He was a member of both the varsity baseball and track teams, member of the American Institute of Chemical Engineers, the Society of American Military Engineers; and was listed in Who's Who in American Colleges and Universities. He is also a member of Phi Lambda Upsilon, Chemical Honorary, and Tau Beta Pi, Engineering honorary fraternities.

Mr. Friedman was born March 11, 1936 in Brooklyn, New York and resides at 11 Stanton Road, Darien, Connecticut.

JOHN CARLTON HALE

JOHN CARLTON HALE, ROTC senior this year at Vanderbilt University, holds the rating of Distinguished Military Student having an outstanding record in both academic and military subjects. Born in Decatur, Alabama on October 5, 1936, his home address is 205 Jarnigan Avenue, Chattanooga 5, Tennessee.

Mr. Hale, majoring in chemical engineering, attained the rank of captain in the ROTC organization. His college activities include: vice-president, Tau Beta Pi, honorary; president, American Institute of Chemical Engineers; secretary, Kappa Alpha fraternity; delegate for Tau Beta Pi; Engineer Council; member junior Athletic Association; intramural football; Pershing Rifles, and Scabbard and Blade. He was the recipient of the University Founder's Scholarship (3 years), and Union Carbide Nuclear Scholarship (1 year).

MARK J. HAYES

MARK J. HAYES, Army ROTC graduate this year from the University of Detroit, received a Bachelor's degree in chemical engineering and obtained a commission in the Army Ordnance Corps Reserve. Mr. Hayes, born May 28, 1935, resides at 371 South Maple Avenue, Ridgewood, New Jersey.

At the University, Mr. Hayes received the Dr. C. G. Duncombe Award and was listed in the Honor

Roll for three semesters. He was a member of Chi Sigma, Engineering social fraternity. He participated in the following activities: St. Francis Club, Engineering Student Council, Slide Rule Dinner Committee, Junior Class Vice President, Junior Prom Committee and the Engineering Show Committee.

During the period 1955-56, Mr. Hayes was employed by Wyandotte Chemicals Corporation in process engineering, and later was engaged part-time with the Curtiss-Wright Corporation in connection with combustion chamber design.

JOHN WILLIAM KANE, JR.

JOHN WILLIAM KANE, JR., Army ROTC senior at the University of Delaware, majored in chemistry. He earned approximately 50% of his college expenses through summer employment; had an outstanding ROTC record.

He was designated Distinguished Military Student, received the Superior Cadet Ribbon Award, was member of the Delaware Rifles Drill Team, served as president of Scabbard and Blade honorary military society.

He attained the rank of lieutenant colonel in the ROTC Corps.

Mr. Kane was on the Dean's List during his first and third year. Other campus activities included: Service Week chairman, House Manager, Executive Committee, American Chemical Society Affiliate, Alpha Chi Sigma pledge, and member Sigma Nu social fraternity.

Mr. Kane was born June 17, 1936 at Wilmington, Delaware and resides at 252 Birch Avenue, Wilmington 5, Delaware.

KENNETH ISAO KAWANO

KENNETH ISAO KAWANO, junior this year at Massachusetts Institute of Technology, majoring in chemistry, was born April 23, 1937 at Hoolehua, Molokai Territory of Hawaii. Mr. Kawano received a scholarship award from the Molokai Chapter, Lions Club. He served as company commander of Company C, 12th Regiment of the Pershing Rifles, national honorary society. He has served as chairman House Judicial Committee, Burton House, and is a member of the College Career Club of Tremont Baptist Church.

Mr. Kawano's student address is Burton House, 410 Memorial Drive, Cambridge 39, Massachusetts.

The A.F.C.A. award was presented to Cadet Kawano at Military Day ceremonies at M.I.T. on May 6 by Mr. Harry A. Wansker, vice-president of the Association.

ROBERT HILDRETH MARIK

ROBERT HILDRETH MARIK, a graduate in chemical engineering this year at Carnegie Institute of Technology, was the recipient for four years of the George Westinghouse National Scholarship, and has been named for a fellowship for first year graduate study at CIT 1958-59.

Mr. Marik was born July 12, 1936 at Rahway, New Jersey. He resides at 714 Boulevard, Westfield, New Jersey. President of Sigma Nu fraternity at CIT, he was also president of the Council of Frat Presidents, president of the Student Chapter of American Institute of Chemical Engineers, president of Scimitar Society, and Treasurer of Delta Skull. He is also a member of the following organizations: Omicron Delta Kappa, Tau Beta Pi, Phi Kappa Phi, Campus YMCA, Student Congress Executive Committee, Undergraduate Advisor Committee, Scabbard and Blade, and Pershing Rifles.

Mr. Marik attained the grade of ROTC cadet major.

DAVID G. MCMASTER

DAVID G. MCMASTER, cadet lieutenant colonel in the Army ROTC, graduating this year at Georgia Institute of Technology, was born December 7, 1934 at Rockwood, Tennessee. His present home address is 807 Kingwood Drive, Murfreesboro, Tenn.

Majoring in chemical engineering, cadet McMaster received a number of awards for academic achievement and has participated extensively in extracurricular activities.

He served as S-3 (Operations Officer) of the Cadet Regiment. His awards included the A.I.Ch.E. Scholarship award (sophomore), Georgia Engineering Society Award (junior), and American Cyanamid Corporation Scholarship (senior). He was on the Dean's List for all quarters of the past year and is a member of the following honorary societies: Phi Kappa Phi, Tau Beta Phi, Phi Eta Sigma, and Briaerian Society. Other campus activities included A.I.Ch.E., American Chemical Society and Baptist Student Union.

RICHARD ARTHUR ROBOHM

RICHARD ARTHUR ROBOHM, who has an excellent record in both academic and military activities at Idaho State College, has majored in bacteriology and chemistry. He attained the cadet rank of major. His campus offices held include: Associated Men Students' Representative on various committees; member of Scabbard and Blade; Association of the United States Army; Student Council, and member of Intercollegiate Knights.

Mr. Robohm was born February 29, 1936 at Jackson, Wyoming. His mailing address is 163 East 20th Street, Idaho Falls, Idaho.

PHILLIP A. OSTRAND

PHILLIP A. OSTRAND, graduate this year of the College of Liberal Arts and Sciences at the University of Illinois, is a second-time winner of the A.F.C.A. medal award. He majored in chemistry. Mr. Ostrand attained the grade of cadet lieutenant colonel and served as executive officer of the Second Regiment of the Cadet Corps. He received the rating of Distinguished Military Student and is accepting a commission in the Regular Army.

Mr. Ostrand's academic average was in the upper 5% of his class. He attended the University on an Illinois

County Scholarship, which attests high scholastic standing in high school. His extracurricular activities at Illinois included: member of Alpha Chi Sigma, honorary chemical fraternity, and member of the Junior Association of the American Chemical Society.

Mr. Ostrand was born November 2, 1936 in Chicago. His home address is 3848 West Loyola Street, Lincolnwood, Illinois.

GARY LYNN ROUBOS

Gary Lynn Roubos, majoring in chemical engineering at the University of Colorado, received the Waiver of Tuition Scholarship for the years 1954-56 and the Boettcher Scholarship award for four years. He was named Outstanding Freshman Engineer for 1954-55. His highest cadet rank was regimental sergeant major.

Mr. Roubos, a member of Sigma Chi social fraternity, was President of the Student Body for 1957-58 and was the campus vice-president of the American Institute of Chemical Engineers for 1956. He was a member of the following honorary societies: Phi Epsilon Phi; Sumalia; Heart and Dagger; Sigma Tau; Phi Lambda Upsilon and Alpha Chi Sigma. He was also a member of the Society of American Military Engineers. He took an active part also in the university celebrations and dances serving on several occasions as Dance Chairman and also as Publicity Chairman.

Mr. Roubos was born in Denver, Colorado November 7, 1936. His home address is 1635 South Cook Street, Denver.

ROBERT FREDERICK SIEVING

Robert Frederick Sieving, as cadet first sergeant in his ROTC Unit at Ohio University, Athens, Ohio, was the recipient of this year's A.F.C.A. medal award. He will be a senior next year.

Mr. Sieving, majoring in agriculture, was listed in the upper bracket of his class both for academic and military studies. He is a member of Delta Upsilon, social fraternity; Omega Upsilon, agricultural society; was adjutant of the Pershing Rifles at the University; has been included in the Dean's List. He is also Devotions Chairman, Lutheran Student Association.

Mr. Sieving was born at Toledo, Ohio, October 18, 1937, his home address being 4159 Garrison Road, Toledo 13, Ohio.

MARK RICHARD SCHIFF

Mark Richard Schiff, majoring in textile chemistry at North Carolina State College, received the A.F.C.A. award as a member of the junior class this year.

Mr. Schiff, who includes individual research in chemistry as one of his hobbies, has shown promise in both scholastic and military fields. He is a drum major and business manager of the College Band, a position which has called for considerable administrative ability. He is a member of the American Association of Textile Chemists and Colorists; a member of Phi Psi, textile professional fraternity; Mu Beta Psi, honorary music society; Scabbard and Blade; Order of the Arrow, honorary scouting organization; and a member of Sigma Alpha Mu, social fraternity.

Mr. Schiff was born January 22, 1938 in New York, N.Y., his home address being 55 Lawrence Street, New Hyde Park, New York.

WILLIAM ROYCE STROUD

William Royce Stroud, colonel of the ROTC Unit at Purdue University, highest attainable grade, was selected there for A.F.C.A. medal this year. Mr. Stroud was active in the College Chapter of A.F.C.A., and majored in chemical engineering. His outstanding record covered both his scholastic index and extracurricular and campus activities.

Vice-president of the Sigma Nu chapter, he also held the office of fraternity historian and chaplain. He is a member of Tau Beta Pi, national engineering honorary ,and Omega Chi Epsilon, national chemical engineering fraternity; an honorary member of the American Society Testing Materials, and a member of the Gimlets. He served on the Junior Prom committee and was a member of the University Choir. In athletics he earned his letter on the Varsity Basketball Team.

Mr. Stroud attained the rank of first sergeant of a drill company in his sophomore year; in his junior year received a Superior Cadet Ribbon, reaching the highest cadet rank as a senior.

Mr. Stroud was born January 23, 1937 at East St. Louis, Illinois.

JAMES LAWRENCE TROUT

James Lawrence Trout, chemical engineering student at University of Cincinnati, won a scholarship for his freshman year and has attained the rank of 2nd lieutenant in his ROTC Unit. He has made the Dean's List; is a member of student chapter of American Institute of Chemical Engineers; Alpha Chi Sigma, professional society; Tau Beta Pi; Phi Eta Sigma; and Phi Lambda Upsilon.

Mr. Trout, while at the University, has earned 50% of his expenses through the cooperative work program. He has served as vice-president of the Dorm Council, and as social chairman, Dorm Social Board. He was born August 7, 1935, at Cincinnati, Ohio. His present address there is 8929 Kaldy Drive.

HERBERT ERVIN WHALEN

Herbert Ervin Whalen, majoring in petroleum and geological engineering at Agricultural and Mechanical College of Texas, has been designated as a Distinguished Student. He was listed as Outstanding Freshman in the ROTC Battalion during his first year and as Best Drilled Sophomore in Company in his second year; made Expert in practice firing with the M-1 Rifle and the Carbine.

The campus activities of Mr. Whalen included the following: member of Geology Club, American Ordnance Association, Phi Eta Sigma fraternity, Baptist Student Union, and SCONA IV. A member of the Army Reserves, he served in the ROTC Unit as supply sergeant of First Regiment Staff, and as cadet master sergeant. He is a member of the Ross Volunteers.

Mr. Whalen was born in Beeville, Texas, on March 1, 1937. His home there is at 800 North Polk Street.

MONTE DALE WITTE

Monte Dale Witte, in the graduating class this year with a major in chemical engineering at the University of Oklahoma, again was selected for the A.F.C.A. medal award. He also won this award in 1957.

Mr. Witte was a 2nd lieutenant in the ROTC. He was president of Delta Chi during 1957; was a member of Alpha Chi Sigma, Phi Eta Sigma, the American Chemical Society, and the American Institute of Chemical Engineers.

Mr. Witte was born August 8, 1937 at Dallas, Texas. where he resides at 7422 Forney Road.

THOMAS EDWARD ZOELLER

Thomas Edward Zoeller, Mathematics major at Saint Peter's College, Jersey City, New Jersey, this year, was awarded an assistantship in Graduate Schools of Mathematics at both the University of Maryland and St. Louis University.

Mr. Zoeller, who held the rank of cadet first lieutenant in the ROTC, was a member of Scabbard and Blade and attained the highest record of the College for rifle firing. He was captain of the Rifle Team during his junior and senior years, and manager of the team during his sophomore year.

Mr. Zoeller was born at Elizabeth, New Jersey, March 1, 1936. His home address is 325 Putnam Road, Union, N. J.

VERNON RICHARD EALES

Vernon Richard Eales, who stands high in his class at Cornell University, received a McMullen Engineering Scholarship and a New York State Scholarship. Among the organizations he belongs to are Quill & Dagger; "Pros Ops," a chemical engineering honorary; Scabbard and Blade, a military honorary; and Narmid, a naval honorary. He has been tutor to freshmen engineering students; was a member of the Varsity Football Team at Cornell for the past three years. In that connection he received a Bob Patterson Memorial Award as the football player demonstrating the most development during his college career. He has been president and pledge master of his social fraternity, Beta Theta Pi, and was also president of Red Key, a Cornell Junior Men's honorary. In the Corps he was midshipman commander and brigade adjutant.

Mr. Eales was born March 4, 1936, at Sayre, Pennsylvania, his present address being 100 Ridgewood Road, Ithaca, N. Y.

JOHN B. LUTZ

John B. Lutz received the A.F.C.A. medal award this year as a member of the Naval ROTC at Columbia University. Mr. Lutz was enrolled for three years in Columbia College before he transferred to the School of Engineering. He received a Bachelor of Science degree in engineering and a commission as ensign in the U.S. Naval Reserve this June.

An above average student in the chemical engineering field, Mr. Lutz also participated extensively in campus affairs. He is a member of Sigma Chi Fraternity. He played with the 150-pound Football Team, and was active in the King's Men (College singing group). In the cadet Corps he reached the rank of midshipman ensign. served as platoon leader, and was highly regarded both for classroom and extracurricular work.

Mr. Lutz's home address is 1203 Hayward Avenue, Cincinnati 26, Ohio.

RALPH WILLIAM STOLL

Ralph William Stoll, majoring in chemistry at the University of California at Los Angeles, holds a Regular scholarship in the Naval Reserve Training Corps. Mr. Stoll, with the rank of ensign, is a platoon commander and recently won the platoon competition at UCLA. He served as executive officer of the midshipman Detachment from the University at the summer cruise of 1957.

Mr. Stoll is a member of Theta Xi in which he has held the offices of secretary, junior executive, vice-president, and president. He has also been business manager of the Executive Board of the University Recreation Association.

He was born January 6, 1937 at Buffalo, New York, his home address now being 50 S. Main Street, Salamanca, New York.

STEVEN ARMSTRONG WOLL

Steven Armstrong Woll, chemical engineering student and member of the Naval ROTC at the University of Wisconsin, not only has a high academic standing but has attained the rank of midshipman lieutenant commander (Battalion executive officer) in the Corps. Although 70% self-supporting he has been active in many college organizations. He has been president of the Tau Beta Pi honorary fraternity; member of Alpha Chi Sigma, Phi Eta Sigma, and Phi Lambda Upsilon honorary fraternities; member of A.I.Ch.E.; member of the NROTC Choir, NROTC Nautilus Society; served on the staff of NROTC newspaper, "Fouled Anchor;" is a member of Calvary Lutheran Social Committee; and has engaged in intramural athletics.

Mr. Woll was born July 25, 1936 at Chippewa Falls,

Wisconsin, and now resides at 1335 11th Street, Fennimore, Wisconsin.

MICHAEL B. BOGOST

MICHAEL B. BOGOST, majoring in chemistry at the California Institute of Technology, Pasadena, California, was selected there for the A.F.C.A. medal award this year. He has been a member of the Air Force ROTC Drill Team for two years and of the Rifle Team for one year. Mr. Bogost plans on a career in the Air Force when he completes his courses at California Tech.

Mr. Bogost was born in Tacoma, Washington. In 1951, his father then being engaged with the Navy for work at Pearl Harbor, he enrolled in high school in Honolulu. He was active in various school organizations there, including membership in the Latin Club and Dramatic Club, and was in the high school ROTC. He enrolled at California Institute of Technology in September 1955.

LESLIE R. DRANE, JR.

LESLIE R. DRANE, JR., who has majored in chemical engineering at Mississippi State College, attained the rank in the Air Force ROTC of colonel. The campus offices he held include president Kappa Sigma, treasurer Phi Eta Sigma (honorary scholastic freshman fraternity), commander Sabre Air Command, and commander Arnold Air Society.

Mr. Drane also won a number of special honors including the $100 engineering freshman scholarship; two $250 scholarships; one $200 area scholarships; the $500 Harmon Connell Award; the Convair Award; the Detachment Award; the Outstanding AFROTC Junior Award; and the Society of American Engineers Award.

Mr. Drane is a native of Mayhew, Mississippi, where he presently resides.

WILLIAM LELAND UNDERKOFLER

WILLIAM LELAND UNDERKOFLER who majored in chemical technology at Iowa State College for Agriculture and Mechanical Arts, Ames, Iowa, attained the rank of lieutenant colonel in the Air Force ROTC unit there. He was a member of the Rifle Team 1955-58 and served as captain of the team in 1957 and 1958. He served as secretary and master of ceremonies of Alpha Chi Sigma, was a member of Phi Lambda Upsilon, chemistry honorary; and of Phi Kappa Phi, Senior scholastic honorary, and Phi Eta Sigma, Freshman scholastic honorary.

Mr. Underkofler was born at Ames, Iowa on November 10, 1936. His present home address is 261 Rose Avenue, RFD #2, Westwood, New Jersey. Among his hobbies is that of amateur radio operator, station K2PIG, Westwood, N. J.

LUMIR JOHN EHERNBERGER, JR.

LUMIR JOHN EHERNBERGER, JR., has attained the rank of cadet lieutenant colonel in the Air Force ROTC at the University of Nebraska. Mr. Ehernberger received a Freshman Regents Scholarship and was given the American Legion award for outstanding accomplishments in high school. He is enrolled in the Arts and Science Course leading to a degree of Bachelor of Science in Chemistry. His campus activities include intramural basketball; Symphonic Band; Building Fund chairman; chairman of Province Program Aids Committee; and the Newman Club.

Mr. Ehernberger was born June 18, 1936 at Columbus, Nebraska. His home address is 704 "D" Street, Schuyler, Nebraska.

GERALD ALLEN WILCOX

GERALD ALLEN WILCOX, majoring in chemical engineering at Ohio State University, was a first lieutenant in the Air Force ROTC when selected for the A.F.C.A. medal award this year.

Mr. Wilcox was secretary of the Engineers Council at Ohio State; had received the A.I.Ch.E. award (1957); the Sons of the American Revolution award (1956); the Reserve Officers of Columbus award (1955). He was a member of Phi Eta Sigma, freshman honorary fraternity; the Council of A.I.Ch.E.; and a member of the Engineering College Speaking Team.

Mr. Wilcox was born November 24, 1936 at Kenton, Ohio.

ORDNANCE

(Continued from page 36)

Sergeant. This solid propellant missile will replace the Corporal. The Sergeant is reliable, accurate and carries a nuclear warhead.

The Redstone missile is 69 feet high, 70 inches in diameter and powered by liquid propellants. It can carry an atomic or high explosive warhead to a range of about 200 miles.

Jupiter. This is a 1500-mile intermediate range ballistic missile being developed by the Army for the Air Force. The Army is currently developing two anti-missile missile systems. One is Plato, a mobile missile designed for use by combat units. The other is Nike-Zeus, which will defend the continental United States and fixed military sites overseas. Both systems will have a nuclear capacity. Development of both systems is moving forward rapidly and we feel confident that they will be successful counter weapons against possible enemy IRBMs and ICBMs.

(General Shinkle concluded his presentation with a film showing in action a series of the Army's guided missiles.—Ed.)

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